UNCLASSIFIED

(2)

AD-A208 185

OPERATIONAL TEST PLAN CONCEPT FOR EVALUATION OF CLOSE AIR SUPPORT ALTERNATIVE AIRCRAFT

31 March 1989

Office of the Director, Operational Test and Evaluation
Office of the Secretary of Defense

UNCLASSIFIED

OPERATIONAL TEST PLAN CONCEPT
FOR EVALUATION OF
CLOSE AIR SUPPORT ALTERNATIVE AIRCRAFT

OPERATIONAL TEST PLAN CONCEPT FOR EVALUATION OF CLOSE AIR SUPPORT ALTERNATIVE AIRCRAFT

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

OPERATIONAL TEST PLAN CONCEPT FOR EVALUATION OF CLOSE AIR SUPPORT ALTERNATIVE AIRCRAFT

EXECUTIVE SUMMARY

The FY 1989 Defense Authorization Amendments and Base Closure and Realignment Act, Public Law 100-526, required the Director, Operational Test and Evaluation (DOT&E) to prepare an operational test plan to conduct a competitive fly-off of alternative aircraft for the close air support (CAS) mission and to complete the test plan ~~by 31 March 1989~~. The Act also directed the Secretary of Defense to conduct an independent assessment of ongoing studies and analyses related to selection of an aircraft for the CAS mission and to examine the feasibility of transferring the CAS mission from the Air Force to the Army. The Secretary of Defense is to provide an interim report to Congress on 31 March 1989 and a final report on 31 December 1989. In conjunction with the interim report, the DOT&E is providing this completed test plan to Congress.

The Army and Air Force have jointly developed a list of requirements for a CAS aircraft. In addition, a mission need statement (MNS) for a fixed wing aircraft has been developed and approved by the Joint Requirements Oversight Council, Office of the Chairman, Joints Chiefs of Staff. These requirements can be grouped into three principal categories: effectiveness in killing assigned targets, survivability and responsiveness.

The USAF has proposed to replace the A-10 Thunderbolt, which is currently its primary CAS aircraft. Air Force assessments have concluded that the A-10, even with an engine modification, cannot survive on current and future battlefields while faster aircraft have significantly greater survivability. The Air Force has recommended that the A-10 be replaced by a modified version of the F-16, which has been designated the A-16. According to USAF assessments, the survivability of the A-16 would be enhanced, relative to the A-10, through a combination of factors including higher attack speeds, hardening, improved low level navigation, automatic target handoff, FLIR and weapons that permit an attack profile that involves a single pass over the target area.

Other recent analyses prepared for the Close Air Support Mission Area Review Group (CASMARG), Office of the Secretary of Defense, have reached different conclusions about the A-10. These analyses indicate that modifications to the A-10, including a new engine and advanced avionics, result in significant improvements in the performance of the aircraft during CAS missions.

Several candidate aircraft, in addition to the A-10 and A-16, have been proposed as alternatives for the CAS mission. Modification of these alternatives to incorporate comparable advanced systems is required to assess fairly their ability to perform CAS in a competitive fly-off. These modifications would be both expensive and time consuming.

TEST CONCEPT

This plan provides for a sequence of tests that will allow an unbiased assessment of each alternative as it performs the CAS mission against a common threat and target base. A wide range of tactical conditions will be evaluated to depict varying levels of conflict from low to high intensity with the associated air defense environments. In view of the expected level of commitment of forces and equipment by the Services and the likelihood of conducting the test on an active Army installation, the Army will be responsible for the detailed design and conduct of the test. The U. S. Army will submit a multi-Service report to DOT&E. Evaluation of the data obtained during the test will be performed by DOT&E.

The Phase I Modification Decision Test will be a quick-look, limited set of trials that could be flown in 12 to 18 months should Congress provide by legislation that such a test be conducted. The purpose of this test is to decide which aircraft should not be modified for a subsequent competitive fly-off. It provides the opportunity to evaluate USAF claims that the A-16 can accomplish the CAS mission and has significantly greater survivability than the modified A-10. The Phase I test can be conducted using current aircraft or surrogate airframes flying proposed operational concepts without investing in prototypes or production representative versions of each alternative.

Phase I will determine the relative effectiveness of the aircraft in killing assigned targets while measuring their ability to survive in getting to the target and returning to their base. Responsiveness will not be tested in Phase I. In addition, this initial test will provide insight into the support required for the more extensive second test, the competitive fly-off.

The Phase II Competitive Fly-off Test will be a side-by-side comparison of designated alternative aircraft with advanced systems in a comparable state of maturity. This test will provide a fair and accurate comparison among alternatives across a range of realistic tactical conditions requiring day and night operations. The relative effectiveness of the alternative aircraft in accomplishing the CAS mission will be measured against the user's requirements of effectiveness in killing assigned targets, survivability and responsiveness.

Realistic operational scenarios are critical to the credibility of these tests. Visits were made to a number of CAS user organizations, where discussions were held with Army, Air Force, Marine Corps and NATO personnel. These discussions were focused on the process by which calls for fire support, originating at division and lower echelons, were eventually translated into requests for CAS. On the basis of the information gathered it was possible to identify, for the tactical situations selected for this test, the type and approximate location of targets that would likely be attacked by CAS aircraft. These visits enabled the development of realistic scenarios for the two tests.

Man-in-the-loop simulation (MILS) will be employed in the planning and conduct of both tests. Simulation will be used to determine potential control problems and sensitivities in the test design. This will allow exploration of the distribution of planned trials, data acquisition techniques and needs. If valid correlation with actual flight trials can be established, MILS could be an adjunct to test execution that may enable variation of parameters not possible during actual trials such as terrain and visibility conditions. It may also be possible to investigate tactics and techniques related to electronic countermeasures, suppression of enemy air defenses, interoperability and signature reduction.

TEST EXECUTION

The Phase I Modification Decision Test will be a series of trials that will emphasize day CAS operations, while providing an opportunity to explore night operations. The A-7, A-10 and A-16 aircraft will be the test articles, with the A-7 potentially as a surrogate for the modified A-10. This test is modular in design and other aircraft types may be directed to participate with an associated increase in cost and time. The trials will be based on the three tactical situations associated with the high intensity European scenario. These situations provide a wide variance in the air defense environment. The test will be conducted at Fort Hood, Texas, and will last approximately 3 months.

The Phase II Competitive Fly-off Test will be a series of trials emphasizing night and limited visibility operations with candidate aircraft selected after completion of Phase I. The trials will be based on the nine tactical situations associated with the European, Middle East/Southwest Asian and Central/South American scenarios described in the plan. This test will be planned for Fort Hood, Texas, but with anticipated improvements in instrumentation and its mobility, it may be possible to use other or additional sites. The duration of the test will depend on the number of candidate aircraft ultimately selected. A minimum of 3 weeks of test trials per candidate will be required, plus time for training and pre-test trials. Table 1 provides a summary of selected aspects of both the Phase I and Phase II tests.

TEST LIMITATIONS

Several potential test limitations have been identified: availability of test sites, availability of threat air defenses, and achieving appropriate combat stress on threat air defenses and aircrews.

There is only a limited number of potential test sites that have the instrumentation required to support the Phase I test, and fewer yet provide ready access to the ground player personnel and equipment needed. Furthermore, transporting the ground force to several sites is very expensive. The risk associated with the selection of a single site for the Phase I test is that the terrain may not be representative of the European scenario to be used in that test.

A credible air defense threat involves appropriate numbers, types and employment of projected enemy equipment and forces. Surrogates and simulators will be used to represent the air defense threat. The significance of such potential limitations will be identified, where possible.

It will be difficult to achieve the appropriate level of combat stress on both threat air defenses and friendly aircrews. The suppressive effects of indirect fires, particularly on dismounted man-portable systems can be only partially represented. In addition, it may not be possible to provide realistic cueing for pilots being engaged by threat air defenses, especially shoulder-fired infrared systems. These conditions should not have a major effect on the relative comparison of test articles.

Table 1. Summary of Selected Aspects of Phase I and II Tests

Test	Purpose of Test	Potential Test Articles*	Scenarios/Situations to be Executed	Anticipated Start Date of Test
Modification Decision Test (Phase I)	• Identify aircraft not to be modified for participation in competitive fly-off • Assess instrumentation requirements for competitive fly-off	A-10A (baseline) A-7 (to surrogate A-10C) A-16 (possibly represented by F-16 with ATHS)	• Central Europe - U. S. defense at FLOT - U. S. counterattack at FLOT - U. S. rear area combat operation	Approximately 12-18 months from a decision to conduct this test
Competitive Fly-off Test (Phase II)	• Determine relative effectiveness of alternative aircraft performing the CAS mission over a broad range of tactical situations	A-10A (baseline) A-10C A-16 AV-8B F/A-18 MUDFIGHTER	• Central Europe - U. S. defense at FLOT - U. S. counterattack at FLOT - U. S. rear area combat operation • Southwest Asia/Middle East - U. S. attack of motorized rifle battalion in tactical march column - U. S. battalion defense against a hasty attack - U. S. battalion counterattack against a hasty defense • Central/South America - U. S. counter ambush - U. S. defense of a fire base - U. S. dismounted attack against a guerrilla base	Approximately 42 months after completion of the Phase I Modification Decision Test (Based on USAF estimates)

*Selection of Phase II test articles to be made after completion of test and evaluation in Phase I.

RESOURCES

The major factors that determine the funding needed to support this test are the friendly and enemy ground forces (personnel and equipment) required to create a credible operating environment, the control organization, transportation and travel costs for player and control personnel, the duration of the test, instrumentation and data processing and simulation and simulator support. Preliminary estimates indicate the cost of the conducting the Phase I Modification Decision Test as described in the plan is approximately $45 million in FY 1990 and $5 million in FY 1991.

The funding required for the Phase II Competitive Fly-off will depend on the number of candidates selected. In addition, a significant investment in instrumentation will likely be required to achieve the desired levels of accuracy for this test. A very preliminary estimate, based on selection of three candidate aircraft and assumptions used to develop the Phase I test costs, indicates approximately $75 million would be required from FY 1992 through FY 1995.

TEST PLAN DEVELOPMENT

This plan has been developed in consultation with the Army Operational Test and Evaluation Agency, the Air Force Operational Test and Evaluation Center and the Marine Corps Operational Test and Evaluation Activity. Members of these organizations participated in the Test Planning Group and the Commanders of these agencies served on a Senior Advisory Group to the Director, Operational Test and Evaluation.

In addition, during the preparation of this plan the Director, Operational Test and Evaluation discussed its development with the Chiefs of Staff of the Army and Air Force. Service comments were solicited and incorporated where appropriate. Suggestions were also received from principal staff members within the Office of the Secretary of Defense.

CHAPTER I
INTRODUCTION

CHAPTER I
INTRODUCTION

A. BACKGROUND

Close Air Support (CAS), according to the *Department of Defense Dictionary of Military and Associated Terms* published by the Office of the Joint Chiefs of Staff (JCS Pub. 1), is "Air action against hostile targets which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of those forces." A theater-level operation, CAS is employed in response to the needs of the ground commander and in accordance with the theater commander's apportionment decision and guidance. The Key West Agreement of 1948 assigned to the Air Force the mission of providing CAS to Army forces. The two aspects of CAS that distinguish it from other tactical air force missions are the "proximity to friendly forces" and the need for "detailed integration" of CAS into the fire and maneuver plans of the Army ground commander. In addition, there is usually an "urgency" associated with CAS that stems from the immediate threat to friendly forces in contact with the enemy.

The close proximity of friendly troops to potential targets and the possibility of very lethal air defenses in the vicinity of those targets place considerable demands on the crews and equipment providing CAS. While all tactical air forces are, in theory, capable of providing CAS, the Air Force has in recent years maintained forces specifically equipped and trained to perform this mission. Since 1976 the A-10 Thunderbolt has been the Air Force's primary CAS aircraft, supplemented where necessary with other aircraft, e.g., the A-7, depending on the theater of operations. The current Air Force force structure includes a total of 6 wings of A-10, representing approximately 600 combat coded aircraft.

Recent Air Force assessments have concluded that by the mid-1990s the A-10 will no longer possess the survivability required to perform adequately the CAS mission in a high intensity conflict environment. Accordingly, the Air Force has recommended that the A-10 be phased out of the inventory beginning in the mid-1990s, to be replaced by a modified version of the F-16, which has been designated the A-16. The survivability of the A-16 would be enhanced, relative to the current A-10, through a

combination of features including higher attack speeds, hardening and an attack profile that involves a single pass over the target area, vice the multiple passes currently employed by the A-10. To facilitate these new tactics, the A-16's navigation and target acquisition capabilities would be improved through the addition of a Forward Looking Infrared (FLIR) sensor and an Automatic Target Handoff System (ATHS). The addition of the FLIR is designed to allow the Air Force to provide CAS during the hours of darkness and during other periods of limited visibility, both of which are important to future Army operations. Currently only a few specially equipped and trained tactical air squadrons flying the A-7 Low Altitude Night Attack aircraft are capable of providing CAS to Army ground forces during periods of limited visibility.

Other aircraft have been suggested as alternatives to the A-10. One alternative is the AV-8B, a V/STOL aircraft operating out of dispersed forward bases in a manner similar to that used by the Marine Corps for CAS. Another is a class of unsophisticated, low-cost, hardened aircraft with day-only capability, frequently referred to as "Mudfighters." Still another possibility involves extending the life of the current A-10 beyond the mid-1990s by upgrading its engines and adding a FLIR and ATHS.

In 1987 the Office of the Secretary of Defense (OSD) established the Close Air Support Mission Area Review Group (CASMARG). The CASMARG, which is chaired by the Deputy Under Secretary of Defense (Tactical Warfare Programs) and includes representation from other OSD agencies, the Office of the Joint Chiefs of Staff (OJCS), the Army and the Air Force, is responsible for assessing alternative solutions for providing close air support to Army ground forces. In fulfilling that responsibility, the CASMARG will review previous CAS-related studies and analyses, will review the CAS Joint Statement of Requirements prepared by the Army and Air Force and approved by the OJCS and will arrange for the conduct of additional studies and analyses, as required. A final report is expected to be forwarded to the Secretary of Defense in the near future.

In October of 1988 Congress passed the FY 1989 Defense Authorization Amendments and Base Closure and Realignment Act, Public Law 100-526, which requires the Secretary of Defense to conduct an independent assessment of Army and Air Force studies and analyses of CAS alternative aircraft and to assess the feasibility of transferring the CAS mission from the Air Force to the Army. In addition, the legislation requires that the Director, Operational Test and Evaluation (DOT&E), in consultation with the Service Operational Test Agencies, develop an operational test plan for a competitive fly-off of alternative aircraft for the CAS mission. The legislation does not, however, specifically

identify the CAS alternative aircraft to be included in such a fly-off. Two DoD reports are to be submitted to the Congress: an interim report by 31 March 1989 and a final report by 31 December 1989.

The OJCS is preparing an assessment to support the Secretary of Defense's response to the first two requirements described above. This assessment includes the development of a mission need statement that will be submitted to the Defense Acquisition Board (DAB) in support of a Milestone O review of the follow-on CAS aircraft.

B. TEST OBJECTIVE AND CRITICAL OPERATIONAL ISSUES

1. Test Objective

The objective of the competitive fly-off described in this operational test plan is to determine the relative effectiveness of alternative aircraft performing the close air support mission over a broad range of tactical situations. Figure I-1 provides a summary of the relationship between Army CAS requirements, factors which affect those requirements and the contribution of CAS to combat capability. This relationship will be used to develop the scope of the proposed test.

Measures of effectiveness are used in this plan as a starting point to facilitate developing data collection and instrumentation plans. The measures of effectiveness to be used will integrate measures of performance representing killing effectiveness, survivability and responsiveness. Illustrative measures of effectiveness include the number of sorties required to achieve a specified level of target kills and targets killed per aircraft lost.

Each of the three CAS requirements described in Figure I-1 is affected by numerous factors. An aircraft's ability to kill targets, given that it survives to reach the target area, is primarily determined by its target acquisition capability, its weapons delivery accuracy, its weapons payload and munitions lethality.

Aircraft survivability is primarily a function of the aircraft's susceptibility to attack by enemy ground fires and its vulnerability to damage given a hit.

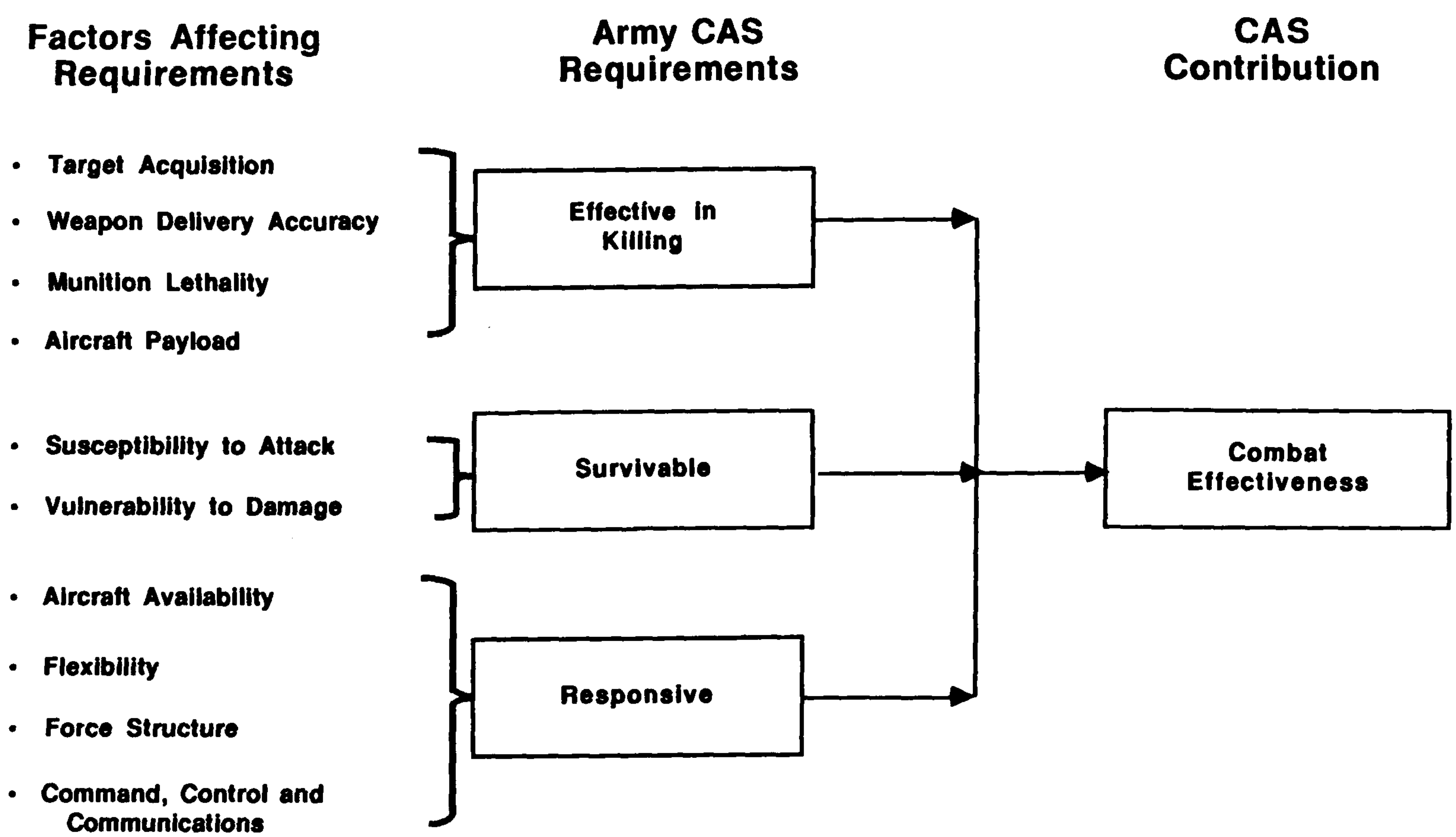


Figure I-1. Determining Combat Effectiveness of Alternative CAS Aircraft

RSM-2-6-89/1

The ability to respond to a call for support in the shortest possible time is an important attribute of the CAS system and of aircraft that are a part of that system. Responsiveness is important because of the urgency frequently associated with requests for CAS that stem from the perceived threat to friendly forces in contact with the enemy. Response time of the CAS system is generally defined as the elapsed time between receipt of a CAS request by the USAF, from an Army element authorized to approve such a request, and the initial attack of the designated target by CAS aircraft. The responsiveness of CAS is affected by a number of factors. Principal among them are aircraft reliability and maintainability, combat damage repairability, flexibility, the availability of minimum operating surfaces for take-offs and landings and facilities for rearming and refueling, the distances between operating bases and potential targets, aircraft speed, force structure and command, control and communications. Flexibility involves the ease with which CAS aircraft can be quickly and efficiently employed at various locations on the battlefield.

Factors affecting responsiveness such as flexibility, the availability of support facilities, distance between operating base and target, force structure and certain aspects of command and control require a context for evaluation which is typically beyond the scope of an affordable operational test. For example, the availability of support facilities, including some that are part of the CAS command and control structure (air operations centers and air traffic management centers), is influenced by their susceptibility to enemy attack, their vulnerability to damage once attacked and the priority the enemy assigns to attacking those facilities. The air and ground forces available to the enemy are a function of his strategic and tactical objectives, the priorities attached to those objectives and his experience in achieving them. Insuring all of these factors are properly constrained in the assessment of their impact on CAS responsiveness requires a broad strategic context.

In view of the above, any treatment of CAS aircraft responsiveness in the test concept addressed in this plan will initially focus on those aircraft-peculiar attributes that can reasonably be accommodated within the scope of an operational test involving combat at the tactical level. These attributes include aircraft operational availability, which is derived from system reliability and maintainability measures, and those aspects of command, control and communications that pertain to the coordination links between Forward Air Controller/Air Liaison Officer, Army aircraft and the CAS aircraft during the final phases of a CAS mission. Operational reliability, availability and maintainability (RAM) data collected on early modification aircraft will be used only to gain insights into the impact those modifications might potentially have on the RAM of the final design. Only

RAM data collected on production representative aircraft will be used for comparisons between aircraft types.

2. Critical Operational Issues

The operational issues to be addressed during the test involve the performance of both current and proposed CAS aircraft.

Issue 1. What is the effectiveness of the current A-10 aircraft, employing appropriate attack techniques, when performing the CAS mission? This assessment provides a baseline against which the performance of proposed changes may be compared. Specific sub-issues to be addressed include:

1. What is the capability of the A-10 aircraft to acquire and accurately engage targets?
2. What is the survivability of the A-10 aircraft while performing the CAS mission?
3. What is the operational responsiveness of the A-10?

Issue 2. What is the relative effectiveness of proposed alternative CAS aircraft, employing appropriate attack techniques, when performing the CAS mission? Specific sub-issues to be addressed are:

1. What is the relative capability of the candidate aircraft to acquire and accurately engage targets?
2. What is the relative survivability of the candidate aircraft while performing the CAS mission?
3. What is the operational responsiveness of each aircraft?

C. ROLE OF MODELS, SIMULATION, AND SIMULATORS

The overall concept for the CAS test and evaluation will involve modeling and simulation to complement the field test phases. Field testing is perceived as the highest source of credible information for operational evaluations, but it is costly in terms of schedule, budget, and demand on resources. Field testing is constricted by safety, range, security, assets, and threat realism considerations. To mitigate some of the field test shortcomings, modeling and simulation can be used effectively.

Modeling, man-in-the-loop simulation (MILS) and simulators will be used to complement field testing through a hybrid architecture of battle and equipment level

operations. This architecture will offset some of the weaknesses of each data source or tool and thus create a more credible and comprehensive evaluation.

D. REPORT ORGANIZATION

Chapter II provides a description of the proposed test. Chapter III is a summary of the tests resources required and a schedule of major events. All tests are subject to some limitations, and Chapter IV contains a discussion of some of the major factors that may affect the validity and potential usefulness of the data and conclusions derived from the proposed test.

CHAPTER II
TEST DESCRIPTION

CHAPTER II
TEST DESCRIPTION

A. TEST CONCEPT AND SCOPE

The purpose of this operational test is to determine the relative effectiveness of aircraft performing the CAS mission over a broad range of tactical conditions. These conditions include combat in high, moderate and low intensity conflict situations. Given the importance attributed to combat under limited visibility conditions in future Army operational concepts, it is also necessary to assess the performance of alternate CAS aircraft during day, night and adverse weather, if the latter is practical. Test scenarios include an active countermeasures environment.

1. Test Overview

Figure II-1 illustrates the overall scheme and method of accomplishing the CAS operational test. The conditions and situations in which the CAS aircraft candidates will be tested represent (to the extent possible) those of the scenarios described in this plan (Section II.B). The CAS operational test will be conducted through field tests on DoD ranges and through use of internetted man-and-equipment-in-the-loop simulation, both employing laydowns and circumstances representative of described scenario environments. Candidate aircraft and the land forces arrayed on the ranges will be instrumented to collect data for measuring the performance of the CAS candidates. Modeling and supporting analysis will provide additional tools to augment and support the objective of the CAS operational test during the planning, execution, and post-test phases.

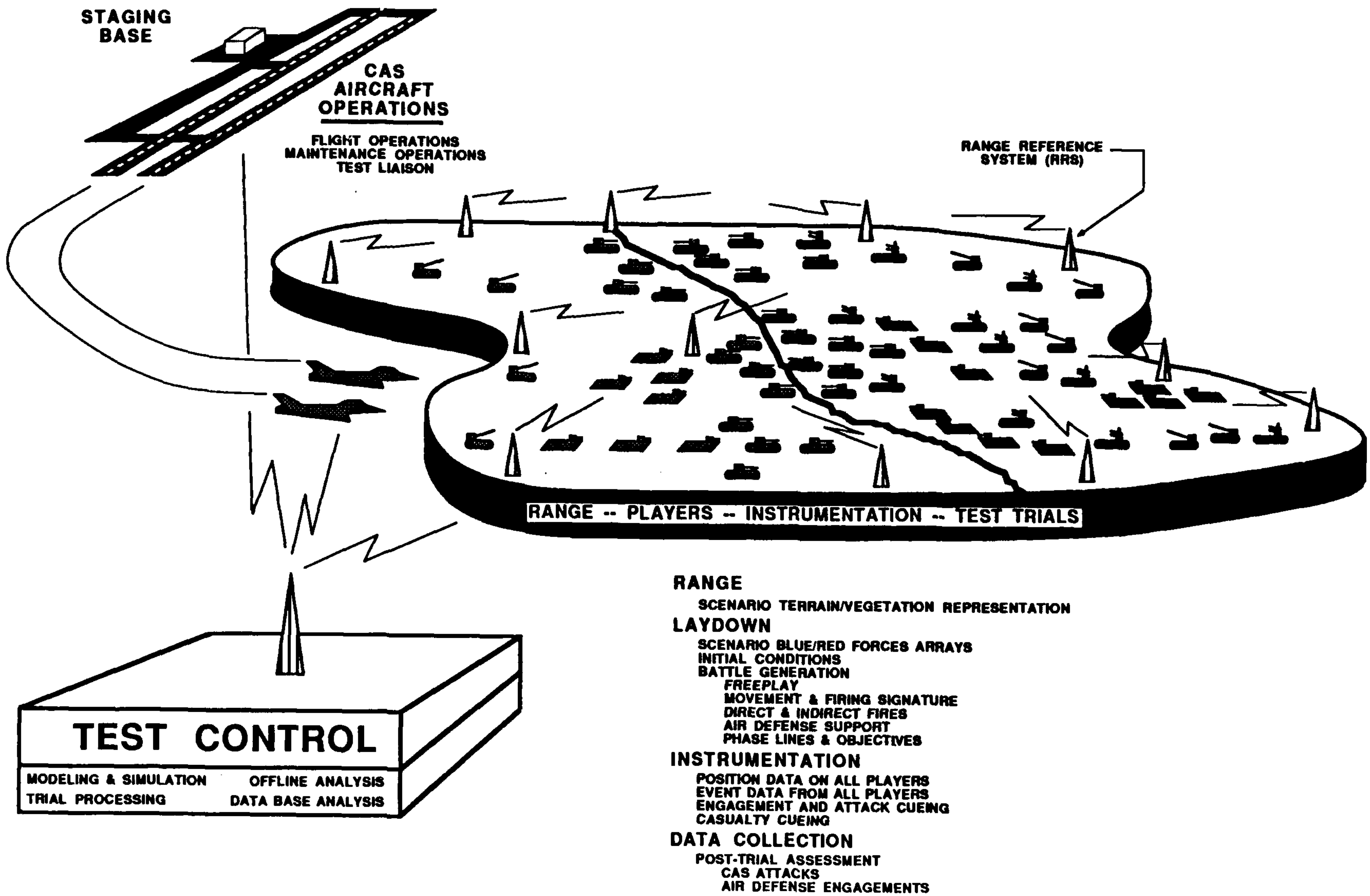


Figure II-1. CAS Operational Test Design/Concept Overview

a. Field Testing

(1) Test Site

A test site to be selected will represent, to the extent possible, the terrain, vegetation, climate, other geographical features, and conditions similar to those of the scenarios described in this plan. Range selection will include considerations such as availability of ground forces, instrumentation, range limitations, and aircraft restrictions.

(2) Laydown

U.S. and enemy ground players consisting of tanks, armored fighting vehicles (AFVs), air defense units, C^2 units, artillery, and other types of equipment will be arrayed to represent the kinds of combat situations described in the scenarios. The ground battle will be a dynamic, free-play encounter. Firing signature devices and casualty cueing will be used to enhance the realism of operational test trials.

(3) CAS Aircraft Candidates

CAS aircraft candidates will be launched from staging bases located in reasonable proximity to the test range. The test articles will be appropriately configured and will operate in a manner to replicate an actual CAS mission. Targeting instructions for the CAS aircraft candidates will be provided by forward air controllers (FACs) or appropriate ground force elements. Target cueing will be provided to the CAS aircraft candidates as appropriate to the attack/munition/profile configurations and tactics of the aircraft being tested.

(4) Free Play

Interactions between opposing hostile ground threats and friendly CAS aircraft are the focus of the CAS operational test. After trial initiation, players will be allowed to conduct operations in a free-play manner, consistent with authorized unit tactics and procedures, and under the restrictions and limitations of the test. CAS aircraft will conduct simulated air-to-ground attacks against assigned hostile targets. No live ordnance will be used during the test, but success or failure of CAS attacks will be scored using recordings of the CAS aircraft attack displays and other instrumentation sources.

Hostile ground player actions will include simulated ground-to-air engagement of attacking CAS aircraft. Hostile air defense operations will be accomplished in accordance with tactics and procedures established for threat participants. Tanks, AFVs, air defense units, artillery and other types of ground participants will provide the bulk of the targets for

the CAS aircraft as opposing ground units engage in the simulated battle. Enemy units will have an opportunity to engage the CAS aircraft with primary or secondary weapons as appropriate to the dynamic battle situations encountered. All enemy air defense data collected by test instrumentation and video recordings will be used to score ground-to-air engagements against the CAS aircraft.

The free-play aspect of the test trial is designed to provide realistic background and conditions from which to measure the performance of candidate aircraft accomplishing the CAS mission. CAS aircraft performance will be measured in terms of their ability to kill assigned targets, their survivability and their responsiveness. CAS effectiveness will be determined by assessed kills imposed on the simulated hostile forces by the friendly CAS attacks. CAS survivability will be determined by assessed losses sustained by the CAS aircraft due to the enemy air defenses during CAS attacks.

(5) Instrumentation

All players will be instrumented to provide position within a common grid as a function of time. This will be accommodated by the range reference system (RRS). Engagement activities conducted by simulated hostile air defense systems against the friendly CAS aircraft will be recorded digitally, on video tape, and by manual form. Attack activities conducted by CAS aircraft against the hostile targets will be recorded on video tape and by manual form. Engagement and attack activities (and associated events) will be time tagged so that locations and relative geometries at time of event can be correlated leading to the shooter and target pairing and assessment of these interactions.

(6) Test Data

Test data will be provided by the instrumentation via magnetic media (digital and video/audio) and by manual forms. Posttrial processing will assimilate these data onto an automated test trial record. Computer output combined with attack and engagement recordings, player position data, and manual forms will be used to assess the outcome of test ground-to-air and air-to-ground interactions. Trial data will be analyzed and events will be reconstructed as required to correct and complete the automated trial data base.

b. Man-in-the-loop Simulation (MILS) in Testing

A man-in-the-loop simulation will be attempted using high fidelity aircraft simulators interlinked with a medium fidelity, unit-level simulation called SIMNET. The approach could consist of near-real-time internetting of a family of simulations as shown in

Figure II-2. The primary measures of performance for the MILS will be identical to those for the field test. It may be possible to use this simulation to accelerate learning before the field tests. The simulation could also be used to refine test scenarios and to develop common scenarios and results for correlation with field testing. With an appropriate level of confidence in the correlation, the simulation could be used to provide more trials to complement field test results. Some of these trials could cover terrain, environmental conditions, additional pilots, and other scenarios/conditions not possible in the Phase 1 field test.

c. Modeling and Supporting Analysis

Computer-based programs which emulate combat interactions among opposing air/ground equipments will be employed to support the planning and conduct of the operational test.

Supporting analysis will also be used as a tool contributing to the operational test. This analysis is in addition to the CAS test trial data base. Supporting analysis can be used to address responsiveness and the operational cost to perform specified CAS tasks for each candidate CAS aircraft. These and other issues can be addressed by using a combination of operational test data, data from supporting analyses, and existing Service data bases.

2. Test Concept

Factors that most significantly affect the test concept described below are the cost and availability for test purposes of likely candidate aircraft and the need to develop information to support near-term DoD and Congressional decisions concerning CAS aircraft program proposals. The latter involve decisions concerning various proposals to modify existing A-10 and F-16 aircraft for test purposes.

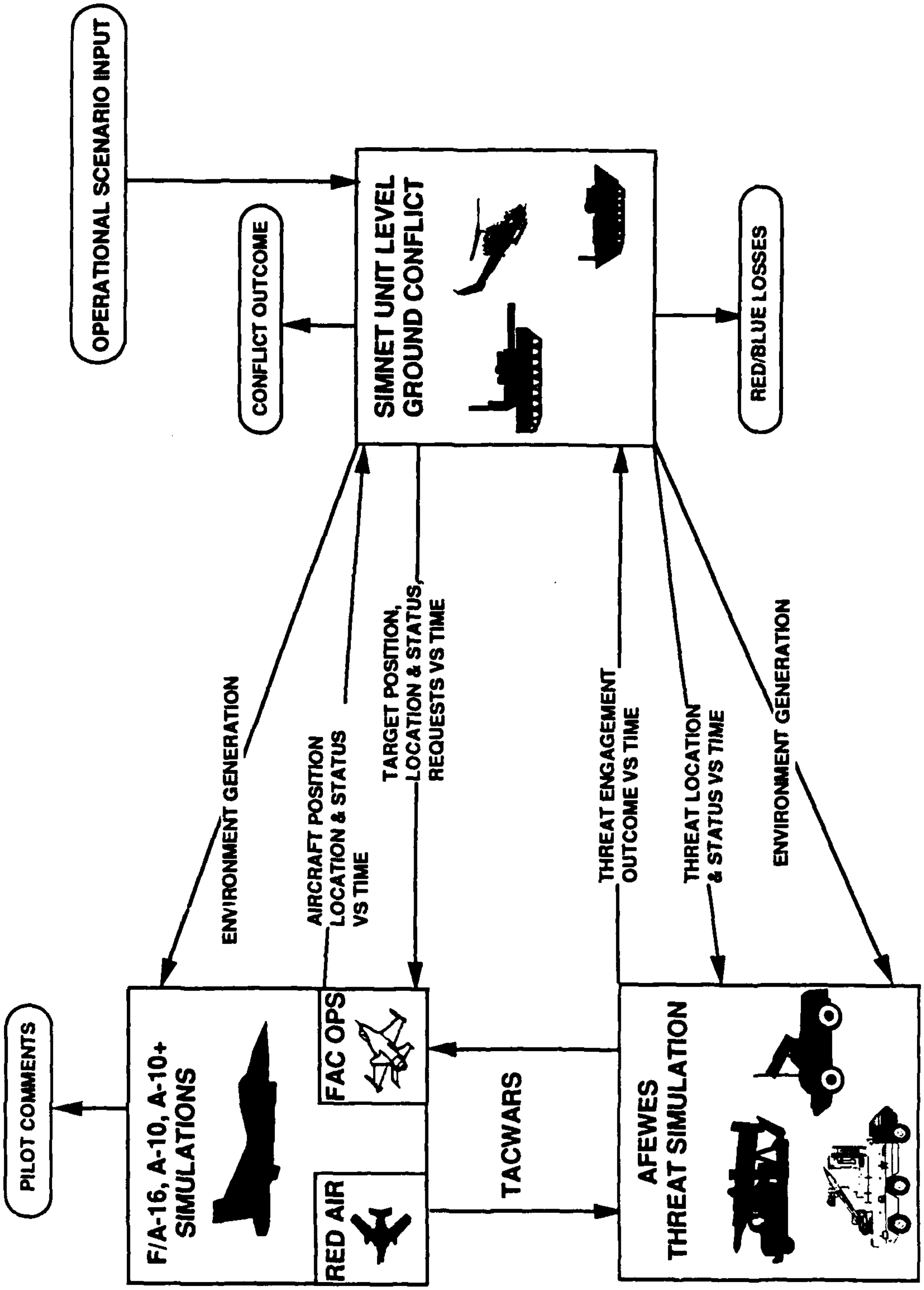


Figure II-2. Phase 1 Simulation Internetting Diagram

Table II-1 provides a summary of the candidate aircraft that would likely be evaluated in a competitive fly-off and their estimated availability for testing.

Table II-1. Alternative CAS Aircraft and Their Availabilities

UNCLASSIFIED

AIRCRAFT	AVAILABILITY DATE
A-10C	FY 92+
A-16	FY 92+
AV-8B	NOW
F/A-18	NOW
MUDFIGHTER	?

It is clear from Table II-1 that a competitive fly-off involving a modified A-10 and the A-16 cannot occur until at least FY 92 to allow for the completion of modifications and necessary crew training. Analyses prepared for the CASMARG indicate that modifications to the A-10 result in significant improvements in the performance and effectiveness of that aircraft. As indicated previously, recent Air Force analyses, prepared by the Tactical Air Command (TAC) and also briefed to the CASMARG, have concluded that the A-10, even with an engine modification cannot perform the mission and survive, while the A-7 and A-16 can perform the mission and have significantly greater survivability.

In view of the preceding issues, a test concept has been developed that involves a sequence of assessments. Phase I would culminate in a test designed to provide information needed to support near-term DoD and Congressional decisions concerning the value of modifying the current A-10 and F-16. Phase II would culminate in a competitive fly-off of designated alternative aircraft. Each of these phases is discussed in greater detail in the following paragraphs.

Phase I. This phase would begin upon receipt of a directive to execute the concept described in this plan. The objectives of this phase would be the detailed design and execution of a Modification Decision Test to develop information that would be used in determining the potential value of modifying the current A-10 and F–16, and subsequently including those aircraft in the Congressionally mandated competitive fly-off. Among the critical tasks that would be accomplished during this phase are:

1. The preparation of a detailed test design plan.
2. The conduct of exploratory trials and manned simulations to confirm the proposed experimental design and instrumentation plans.
3. The conduct of test trials and analysis of results to:

   a. Determine the performance capability of the A-10, thereby establishing a baseline for future comparisons.

   b. Determine the desirability of modifying the A-10 and F-16.

This Phase I Modification Decision Test would be conducted approximately 12 to 18 months after a decision to conduct the test, but no earlier than mid-FY 90. It would address the A-10, the improved A-10, and the A-16.

By FY 90 the developmental version of the A-16 will likely not possess all of the capabilities normally attributed to that aircraft, e.g., fully integrated ATHS and FLIR and hardening. However, sufficient capability should exist to allow meaningful comparisons with other tested aircraft. The Air Force has already conducted technical demonstrations with the developmental version of the A-16 at Fort Hood, Texas and Cold Lake, Canada. Phase I of the evaluation would provide an opportunity to collect data about the A-16 in an environment that would facilitate subsequent comparisons with other CAS aircraft. If adequate numbers of A-16 cannot be made available for the proposed Phase I test, the F-16 with ATHS could be used as a surrogate for the A-16.

As indicated in Table II-1, a modified A-10, the A-10C, cannot be available until at least FY 92, therefore a surrogate of that aircraft would be required in the Modification Decision Test if the potential value of the A-10 modification is to be evaluated. Selection of a surrogate for the modified A-10 in this test should emphasize comparisons of the signature, speed and agility of the aircraft under consideration. Aircraft hardness, while important to system survivability, is incorporated in the evaluation after the completion of each trial, and therefore is not critical to this selection process. Recent analysis performed for the CASMARG has indicated the A-7 would provide a suitable surrogate for the modified A-10. Its speed and agility provide at least a match for the up-engined A-10, and the visual, infrared and radar signatures of both aircraft are large enough not to restrict the effective range of any of the projected threats. Alternatively, a "clean" version of the current A-10, stripped of external pods to reduce drag, and removable armor to reduce weight, may also provide an adequate surrogate for an up-engined A-10 with external devices.

To minimize costs, the Modification Decision Test will involve only those aircraft whose modifications are under consideration. Since there are no pending modifications associated with the AV-8B and F/A-18, they have not been included in the Phase I test. This test is modular in design, however, and the number of aircraft participating may be increased beyond the three previously described with an associated increase in cost and time. In addition, the test conditions will be limited to the high intensity conflict environment addressed in recent studies presented to the CASMARG. This environment is represented by the Central Europe scenario described in Section B of this chapter.

Phase II. This phase of the evaluation would culminate with the Competitive Fly-Off Test. Planning for this test would be conducted in parallel with preparations for the Phase I Modification Decision Test, with the Competitive Fly-Off scheduled to take place about 42 months after a decision to execute Phase II. This accounts for the time required to modify and flight qualify likely candidates as estimated by the USAF. See Appendix F.

The Phase II Competitive Fly-Off Test will address the entire range of potential tactical situations, including high, moderate and low intensity conflict scenarios. It will emphasize operations during limited visibility conditions, such as at night and during adverse weather if conditions permit. Countermeasures would be addressed as appropriate to the scenario.

The Competitive Fly-Off could include the current A-10, the modified A-10, the A-16, the AV-8B, the F/A-18 and an aircraft selected from that class usually referred to as "Mudfighters." The decision concerning which candidate aircraft would participate in this test would likely be made by the Secretary of Defense after an assessment of the results of the Modification Decision Test, and in conjunction with information derived from other sources.

Table II-2 provides a summary of selected aspects of each phase of the proposed CAS operational test concept.

The remainder of this chapter provides a more detailed discussion of the design of each test, including scenarios, numbers of trials by type aircraft, measures of performance, data requirements, and instrumentation.

Table II-2. Summary of Selected Aspects of Phase I and II Tests

Test	Purpose of Test	Potential Test Articles*	Anticipated Start Date of Test
Modification Decision Test (Phase I)	• Identify aircraft not to be modified for participation in competitive fly-off • Assess instrumentation requirements for competitive fly-off	A-10A (baseline) A-7 (to surrogate A-10C) A-16 (possibly represented by F-16 with ATHS)	Approximately 12-18 months from a decision to conduct this test
Competitive Fly-off Test (Phase II)	• Determine relative effectiveness of alternative aircraft performing the CAS mission over a broad range of tactical situations	A-10A (baseline) A-10C A-16 A-8B F/A-18 MUDFIGHTER	Approximately 42 months a decision to execute the Phase II test. (Based on USAF estimates.)

*Selection of Phase II test articles to be made after completion of test and evaluation in Phase I.

B. OPERATIONAL SCENARIOS

1. Role of Scenarios in Test Design

Scenarios describe the operational context in which combat systems are evaluated. Scenarios include general descriptions of the forces to be employed, the missions they have been assigned and the environments in which they must operate. From these general descriptions, specific tactical situations are derived that provide the initial conditions used in structuring actual test trials.

Scenarios, and the resulting tactical situations, are selected to provide the desired range of variability in those factors deemed critical to the issues at hand. In a test of alternative CAS aircraft those critical factors include normal environmental conditions, potential target types, activity and their distribution on the battlefield and the air defenses against which those CAS aircraft must operate. Variations in the latter must take into consideration not only the quality and quantity of the air defenses deployed, but also their density, their disposition and their readiness to participate in the air battle.

2. Selecting a Set of Scenarios and Tactical Situations

In selecting a set of scenarios and tactical situations for the CAS operational test, examples from Service combat development activities, training exercises and recent DoD studies were reviewed to identify plausible circumstances in which CAS sorties might be required to support ground forces. A representative list of activities and associated sources is provided in Table II-3.

Table II-3. Sources of Scenarios

Activity	References
U. S. Army TRADOC Analysis Center, Fort Leavenworth	Documented and in-progress high resolution combat development scenarios
Marine Corps Development and Education Command, Quantico	Documented midrange threat scenarios and target lists
Close Air Support Aircraft Design Alternatives Study (CASADA)	CASADA Study Mission Requirements Package
IDA CAS/BAI Study for OSD	In-progress briefing reports
Warrior Preparation Center, Einsiedlerhof Air Station	Observations made by analysts during training exercises

The scenarios and situations identified through these sources were then discussed with Army, Air Force, Marine Corps, and NATO personnel directly involved in planning for and employing CAS. The organizations visited include the U.S. Air Force Tactical Air Command (TAC); the U.S. Central Command (USCENTCOM); XVIII Airborne Corps and the 82nd Airborne Division; the U.S. III Corps, its subordinate divisions and selected brigades; the 712th Air Support Squadron, which plans and coodinates air support for the III Corps; and the U.S. V Corps and the 4th Allied Tactical Air Forces (4ATAF) in Europe. Visits to III Corps and the 712th Air Support Squadron included observation of field exercises that involved CAS operations.

On the basis of this assessment, a set of three scenarios involving nine tactical situations was selected as being realistically representative of the spectrum of operations in which CAS would be employed. A list of these scenarios and situations is provided below. In each case, the tactical operation implied by the title, e.g., counterattack, refers to the mission of the U.S. force requiring CAS.

- **Central Europe Scenario (High Intensity)**
  - Defense at the forward line of troops (FLOT)
  - Counterattack at the FLOT
  - Rear Area Combat Operation
- **Southwest Asia/Middle East Scenario (Moderate Intensity)**
  - Attack of a Motorized Rifle Battalion in Tactical March Column
  - Defense Against a Hasty Attack
  - Counterattack Against a Hasty Defense
- **Central/South America Scenario (Low Intensity)**
  - Counter-ambush
  - Defense of a Fire Base
  - Dismounted Attack Against a Guerrilla Base Camp

Three very different geographical regions were selected to achieve the desired variation in potential enemy forces and air defense lethalities. The nature of the threats to U.S. interests in these regions differs significantly, ranging from the very large, mobile and armored forces of Central Europe to the very light, predominantly foot-mobile, irregular infantry of Central/South America. The situations in Southwest Asia/Middle East, on the other hand, provide for a middle ground; while the threats tend to be relatively

modern, mobile and predominantly armored as in Central Europe, equipment is generally of an older generation and operations are usually distributed over a much larger area. This distribution of forces has an effect on the coverage provided by threat air defenses.

In each geographic region both offensive and defensive operations were included in the situations selected, as the mission of the enemy force affects both the posture of the likely CAS targets and the coverage provided by the air defenses against which the CAS must operate.

When on the offense, enemy formations tend to be on the move and frequently in the open, thus simplifying the aircraft's target acquisition problem. At the same time, enemy air defenses must maintain an umbrella of coverage over the advancing forces, which requires periodic displacement. During these displacements, only some fraction of the vehicular-mounted air defense systems is usually available to participate in the air battle. Furthermore, when the enemy forces are advancing, the man-portable air defense systems that customarily accompany the maneuver forces are usually inside their carriers and not available for immediate employment.

During defensive operations, on the other hand, the motorized rifle and tank units are relatively stationary, occupying prepared positions that take advantage of available cover and concealment. This tends to complicate the air-to-ground target acquisition problem. Also, since the forces being protected are less mobile in the defense, a larger fraction of the available air defenses is able to participate in the air battle. Under these less fluid conditions, the man-portable air defense systems are more likely to dismount their carriers and supplement the firepower of the vehicular mounted systems.

There is yet another critical aspect to developing scenarios: each situation must include the full range of targets that CAS aircraft likely would attack under the circumstances of the scenario. During visits to the organizations described previously, discussions were held concerning the process by which calls for fire support, originating at division and lower tactical echelons, were eventually translated into requests for CAS. On the basis of these discussions it was possible to identify, for the various situations, the type and approximate location of targets that CAS aircraft likely would attack.

3. Description of Scenarios and Situations

In subsequent paragraphs each scenario and the related tactical situations are described in greater detail together with an illustration describing the disposition and

composition of the forces involved. These illustrations provide some insight into the likely distribution of CAS targets on the battlefields that will be replicated during trials conducted during the CAS operational test. In addition, these schematics reflect the numbers, types and likely distribution of enemy air defenses that would be present under the circumstances represented. *These illustrations are notional and are designed to provide the reader with a visual perspective of the situation that will be represented in the test. The actual deployment of the forces will necessarily depend on the terrain at the test site selected. Specific details concerning the actual threat ground-based air defenses anticipated in these situations during the mid-1990s, and which will be represented in the proposed test, are provided in a separate, classified appendix to this plan. A summary and explanation of the symbols used in the following scenario figures is provided in Appendix H.*

The proposed test focuses on air-to-ground interactions in the vicinity of potential CAS targets, where the primary threats to CAS aircraft are ground-based air defenses. Enemy air is the primary threat to CAS aircraft while the latter are in-transit between staging air base and the target area, and return. Therefore no enemy air will be played in these tests. Data on CAS aircraft losses during those phases of the CAS mission, which are collected routinely during USAF Red Flag exercises, can be used to supplement data collected in the proposed CAS test to broaden the scope of subsequent analysis, as required.

a. Central Europe

Central European weather is typically characterized by low ceilings and limited visibility much of the year. Restrictions to visibility such as snow, dust, battlefield smoke and debris affect both air-to-ground and ground-to-air target acquisition. Much of the terrain is rolling with a combination of open and forrested areas.

Conventional combat operations can be characterized by a major enemy offensive involving multiple fronts, each comprising several combined arms armies deployed in depth. These forces will possess state-of-the-art equipment and will make maximum use of countermeasures to jam communications and degrade target acquisition by CAS aircraft. Threat air defense units will provide overlapping area and point coverage for the forces near the FLOT.

The three tactical situations selected to represent the combat environment in Central Europe are described in the following paragraphs.

(1) U.S Defense at the FLOT

A U.S. battalion task force operating in the area of the enemy's main effort would likely be facing a first echelon regimental formation including a mix of motorized rifle and tank battalions, artillery, mortars, air defenses and related command and control facilities, followed by elements of a regimental second echelon. The disposition of forces is shown in Figure II-3. CAS targets, which are distributed to a depth of about 15 kilometers beyond the FLOT, would likely include attacking company-sized formations of motorized infantry and tank vehicles, air defense systems and artillery/mortar units. The forces contained in the inset of Figure II-3 would be those represented in the test trials.

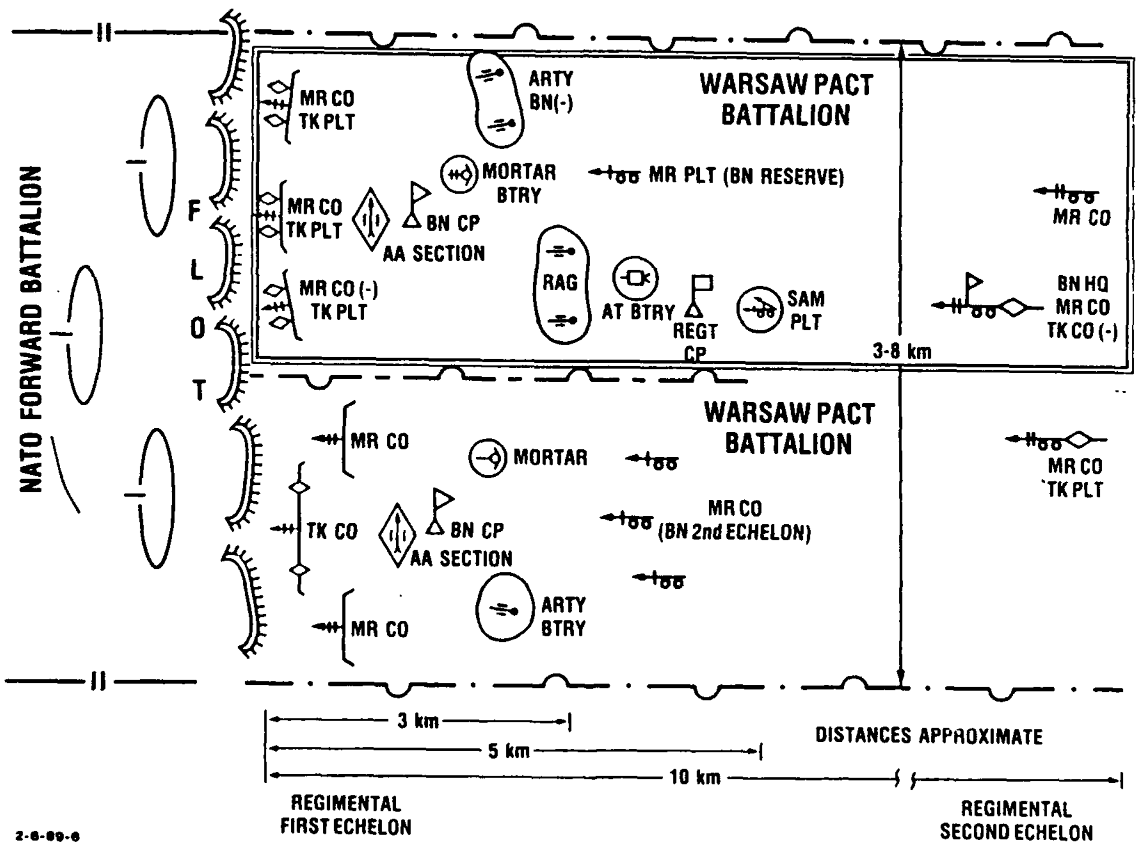


Figure II-3. Central Europe - U.S. Defense at FLOT

(2) U.S. Counter-attack at the FLOT

The initial enemy offensive action described in Section (1). above has created a penetration of the FLOT. Once that situation has been stabilized, the U.S. Corps, in whose area the penetration has occurred, initiates a counterattack to restore the FLOT. As part of this counterattack, a U.S. heavy brigade launches an attack against an enemy battalion occupying a hastily prepared defensive position on the flank of the penetration. Likely CAS targets include forward deployed tank and motorized rifle units, with the latter's infantry dismounted, mounted reserves, air defense units to include dismounted man-portable systems and artillery/mortar positions. The forces deployed in the inset of Figure II-4 are those that would actually participate in the test trials.

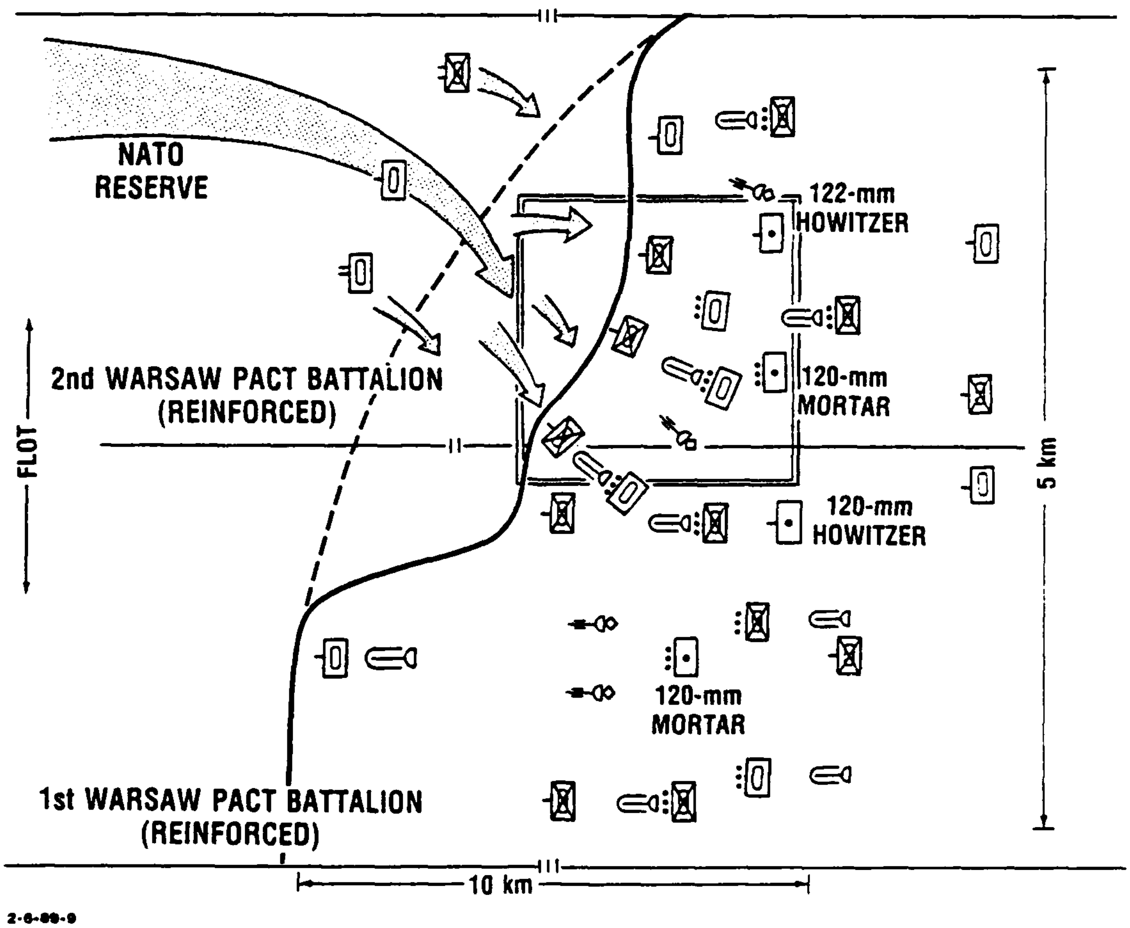


Figure II-4. Central Europe - U.S. Counterattack at FLOT

(3) U.S. Rear Area Combat Operation

During the enemy's initial offensive action, a battalion-size airborne force, as part of a larger operation designed to isolate the forward battle area, was air lifted into the U.S. Corps rear area to seize a river crossing site. Elements of this infantry battalion have occupied company- and platoon-size blocking positions along routes leading to the crossing site. See Figure II-5. A small reserve, the battalion command post and a mortar battery supporting the enemy operation are located in the vicinity of the crossing site. The U.S. Corps, in whose area the site is located, has sent elements of two mechanized infantry battalions to destroy the enemy forces and secure the crossing site. Targets for the CAS flown in support of the U.S. attacks will include the dismounted infantry in covered and concealed blocking positions, the reserve force, the command post and mortar positions. Enemy air defenses in this situation are relatively light, consisting primarily of man-portable systems with very limited command and control.

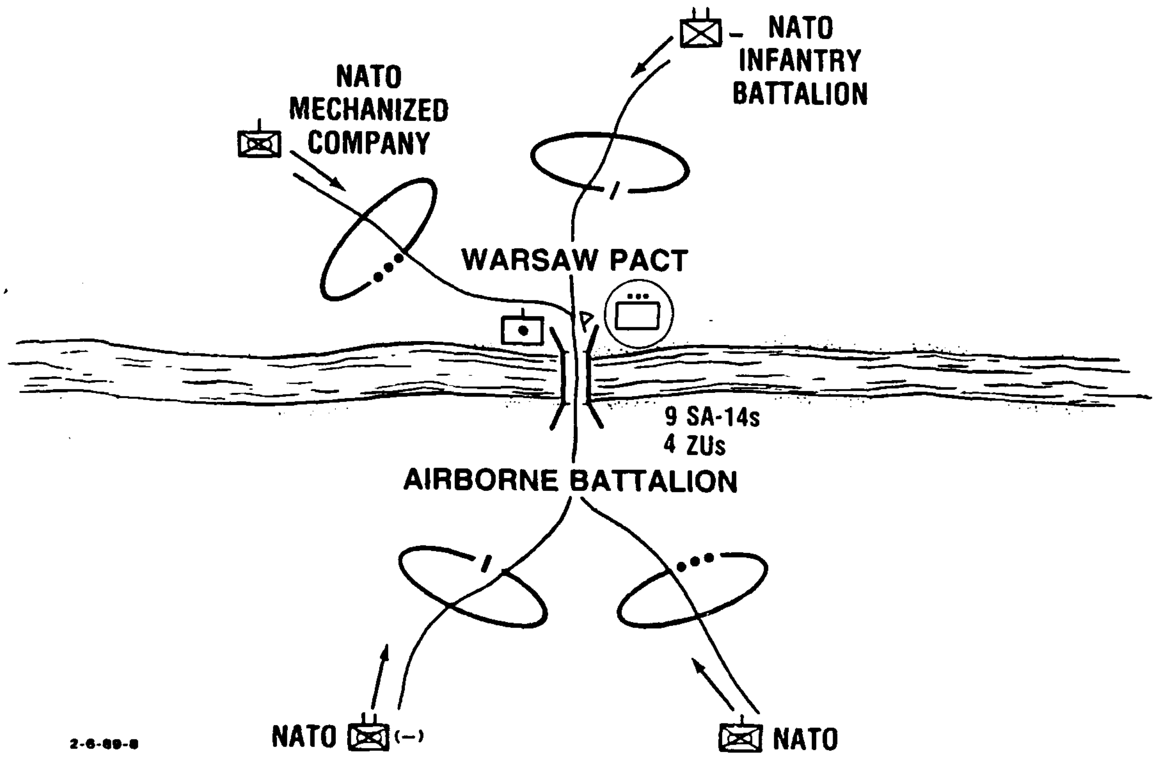


Figure II-5. Central Europe - U.S. Rear Area Combat Operation

b. Southwest Asia/Middle East Scenario

Southwest Asia and the Middle East are characterized by limited road nets, sparsely populated areas and, with some exceptions, good visibility. The few exceptions to good visibility are daily and seasonal fluctuations along coastal areas and during sandstorms. Battlefield smoke and debris and the movement of large forces will provide visual cues at long ranges, but will not linger long over the battle area. The terrain is more extreme than in Central Europe, varying from arid desert to rugged mountains. Both can create severe restrictions to ground maneuver.

Several major differences distinguish combat operations in this region from those in Central Europe. In addition to the environmental distinctions, the operations occur over a much larger area due to the terrain and limited road network. The result is widely dispersed forces operating on a limited number of fairly narrow avenues of approach. The military threats to U.S. interests in this region are usually organized similar to, but employ somewhat older equipment than, those encountered in Central Europe. The typical spacing between forces, however, frequently makes mutual support between their elements, particularly by air defenses, much less likely than in Central Europe.

The three tactical situations selected to represent combat operations in this region are described below.

(1) U.S. Attack of a Motorized Rifle Battalion in Tactical March Column

In this situation the lead elements of an enemy motorized rifle division are advancing along a major avenue of approach. Their mission is to clear and secure a transportation center located along their route of advance and occupy defensive positions to preclude U.S. forces from retaking the facility. A U.S. battalion-size force is currently occupying defensive positions in the vicinity of the enemy objective. As the enemy lead elements approach the U.S. security forces forward of the battalion's main defenses, they are taken under fire and forced to deploy into assault formations. The security forces then conduct a delaying action, eventually passing through the battalion's main defensive positions. CAS missions are flown against elements of the enemy's advance guard while in march column and during early skirmishes with U.S security forces. Figure II-6 provides a description of the composition and initial deployment of the enemy lead elements that will be portrayed in the test trials.

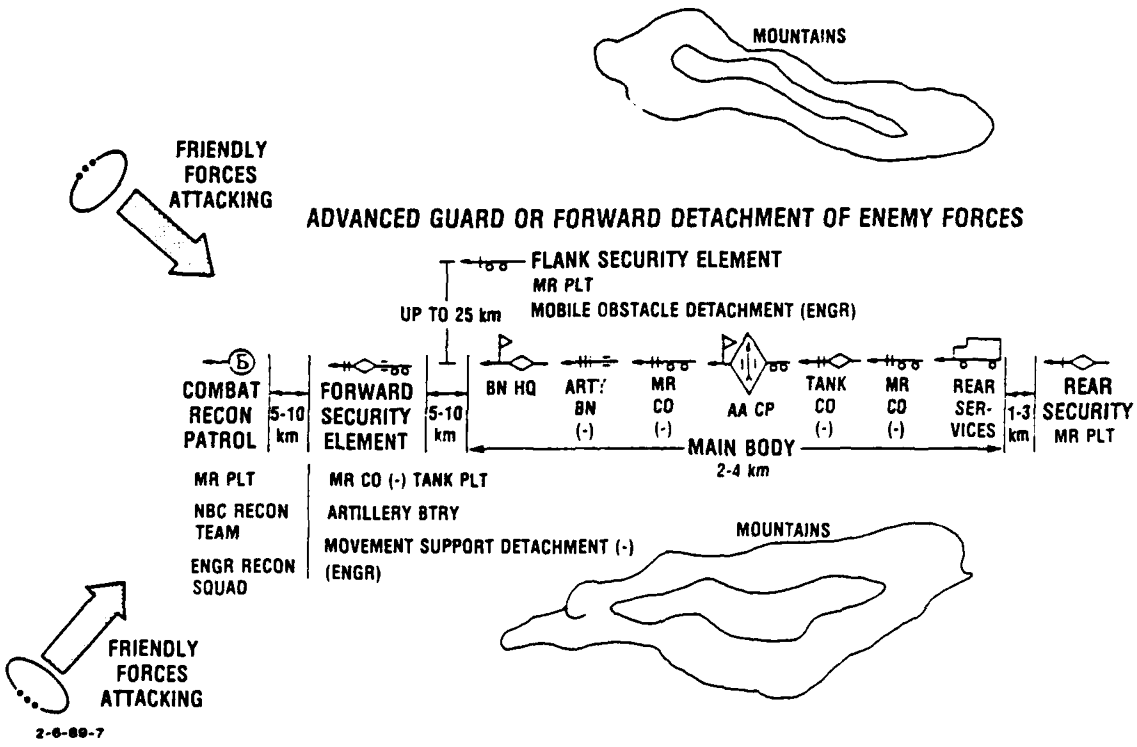


Figure II-6. Southwest Asia/Middle East - U.S. Attack of a Motorized Rifle Battalion in Tactical March Column

(2) U.S. Battalion Defense Against a Hasty Attack

In this situation, the lead regiment of the advancing enemy division deploys to conduct a hasty attack against the battalion's primary defensive positions. Figure II-7 describes the deployment of one battalion of that lead regiment conducting a hasty attack against a reinforced U.S. infantry company. Potential CAS targets include motorized rifle and tank formations, air defense systems, artillery and mortar units.

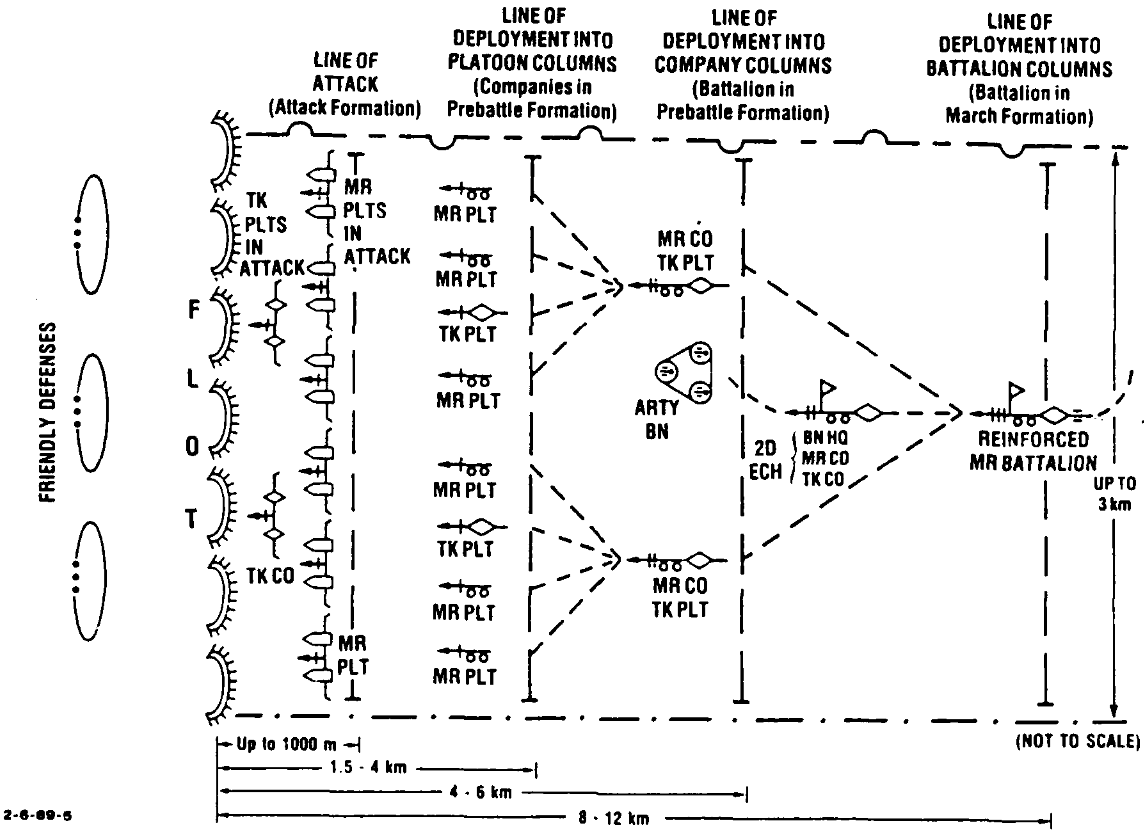


Figure II-7. Southwest Asia/Middle East - U.S. Battalion Defense Against A Hasty Attack

(3) U.S. Battalion Counterattack Against a Hasty Defense

In this situation the enemy forces have secured the transportation center, and are occupying hasty defensive positions designed to control access to that facility. U.S. forces counterattack to retake the center. The deployment of enemy forces in the hasty defense is described in Figure II-8, illustrating the distribution of likely CAS targets. Test trials would represent a reinforced U.S. infantry battalion counterattacking against a reinforced enemy company as indicated in the inset to Figure II-8.

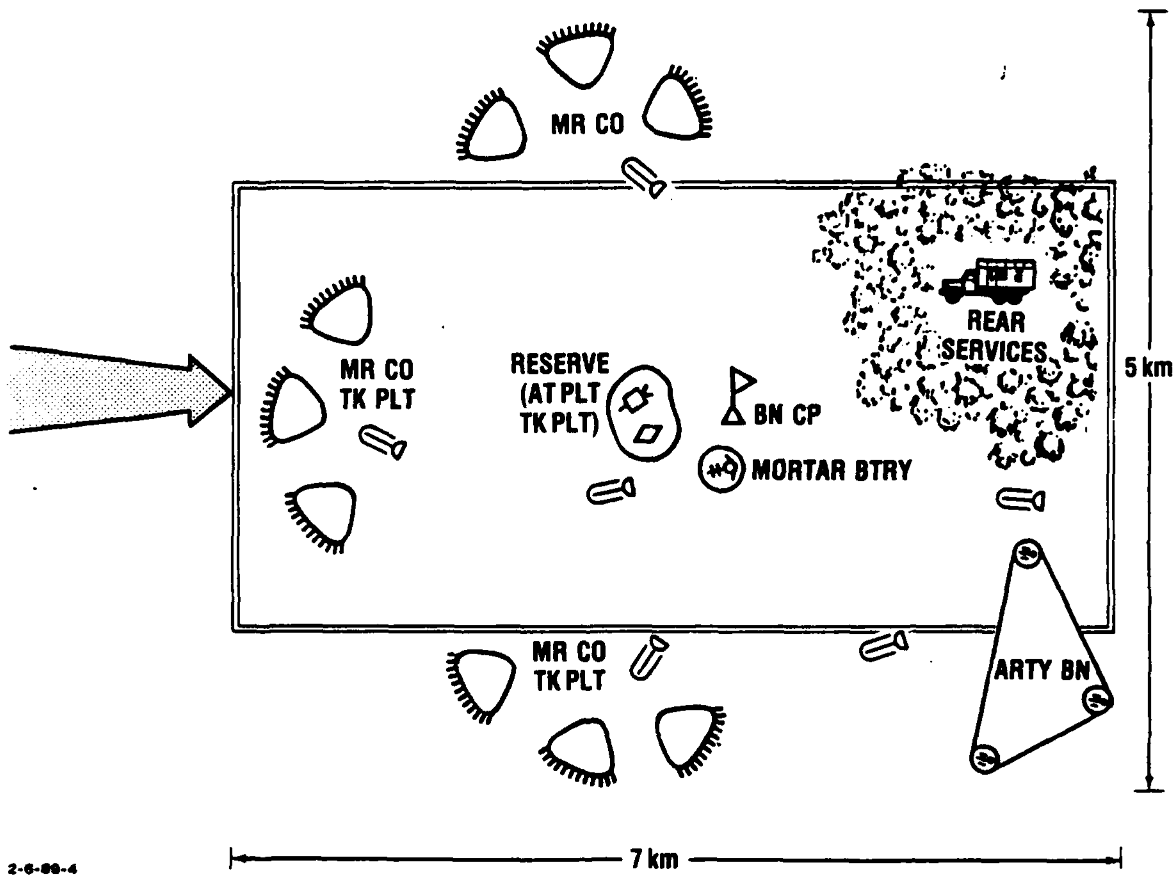


Figure II-8. Southwest Asia/Middle East - U.S. Battalion Counterattack Against a Hasty Defense

c. Central/South America Scenario

The terrain in Latin America ranges from flat and rolling to very mountainous. Much of the area is characterized by very heavy foliage which makes air-to-ground target acquisition quite difficult. Factors that distinguish operations in this region from those in Central Europe and Southwest Asia/Middle East include the size, type and equipment of the forces involved, relatively decentralized control of ground operations, lack of well defined fronts, the intermingling of combatants and non-combatants, and the difficulty in separating friend from foe.

Military operations in the region usually involve relatively short, intense firefights between small units, typically squads, platoons and companies. These battles are widely distributed over the operational area, thus complicating the task of providing adequate artillery fire support to friendly ground forces and increasing the need for responsive CAS. Threat air defenses, which consist primarily of limited numbers of older, man-portable missile systems and light, small caliber, automatic weapons, are lethal but lack the intensity, e.g., quantity, quality and mix of systems, encountered in Central Europe and Southwest Asia/Middle East. CAS targets in this region usually include dismounted infantry in the open and in covered prepared positions, mortar positions and air defense systems.

The three tactical situations selected to represent combat in this region are described in the following paragraphs.

(1) U. S. Counter-Ambush

An irregular infantry company has occupied ambush positions along a supply route used to sustain forces allied with the U.S. See Figure II-9. Fire support from artillery, helicopter gunships and CAS has been planned along the route as part of normal security precautions. In addition, a small security force of mounted infantry accompanies each convoy traveling on this route. In the test trials, the convoy is attacked by the ambush force, which results in a dismounted battle between the U.S. security forces and the ambushers. CAS missions are flown against enemy positions along the ambush site. Shoulder-fired surface-to-air missiles (SAM) and small caliber automatic weapons constitute the primary enemy air defenses.

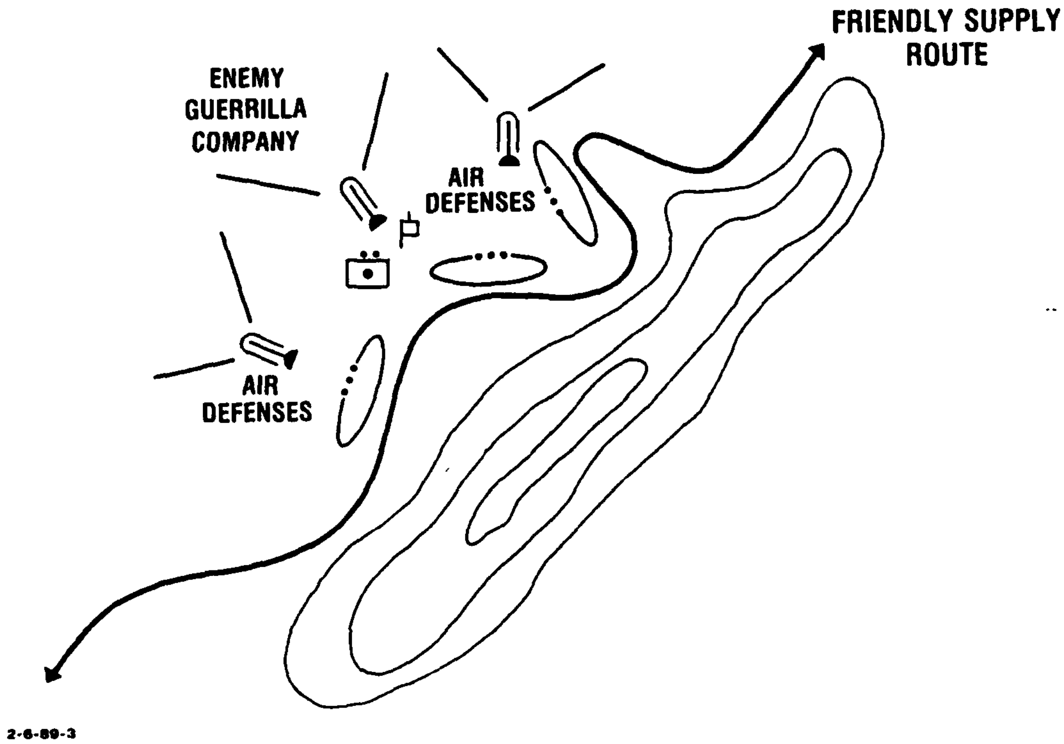


Figure II-9. Central/South America - U.S. Counter-Ambush

(2) U. S. Defense of a Fire Base

A U.S. fire base, consisting of an artillery battery and an infantry company for security, has been established to support friendly ground operations in the surrounding area. An enemy infantry battalion has been assigned the mission of attacking and destroying the fire base. The disposition of enemy forces in the attack is described in Figure II-10. During the assault, artillery fire from a nearby fire base as well as CAS are used to support the infantry defending the base. The artillery within the fire base under attack is used in a direct fire role to repulse the enemy assault. CAS targets include the dismounted infantry attacking the base and mortar positions being used to support that attack. Enemy air defenses include man-portable SAM and small caliber automatic weapons.

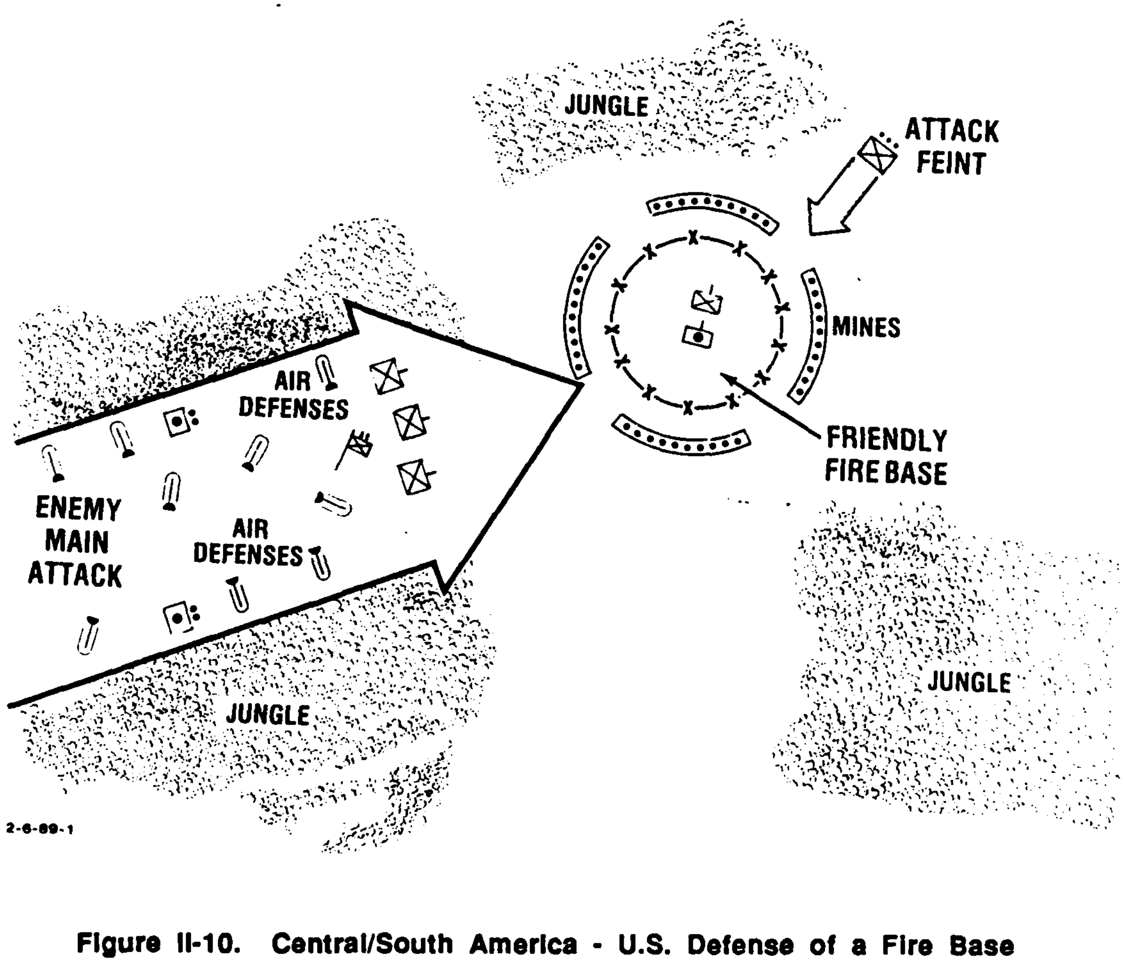


Figure II-10. Central/South America - U.S. Defense of a Fire Base

(3) U. S. Dismounted Attack Against a Guerrilla Base Camp

In this situation a U.S. infantry company conducting security operations in the vicinity of a fire base encounters an enemy company-size base camp. Prior to the arrival of the U.S. company, the enemy force had begun to withdraw from the base camp, leaving a reinforced infantry platoon to cover its withdrawal. The U.S. infantry company, taken under fire by the enemy platoon as it approaches their position, conducts a hasty attack against the base camp, supported by artillery and CAS. See Figure II-11. Principal CAS targets are the enemy dismounted infantry in prepared defensive positions and mortar sites. Primary enemy air defenses consist of man-portable SAM and small caliber automatic weapons.

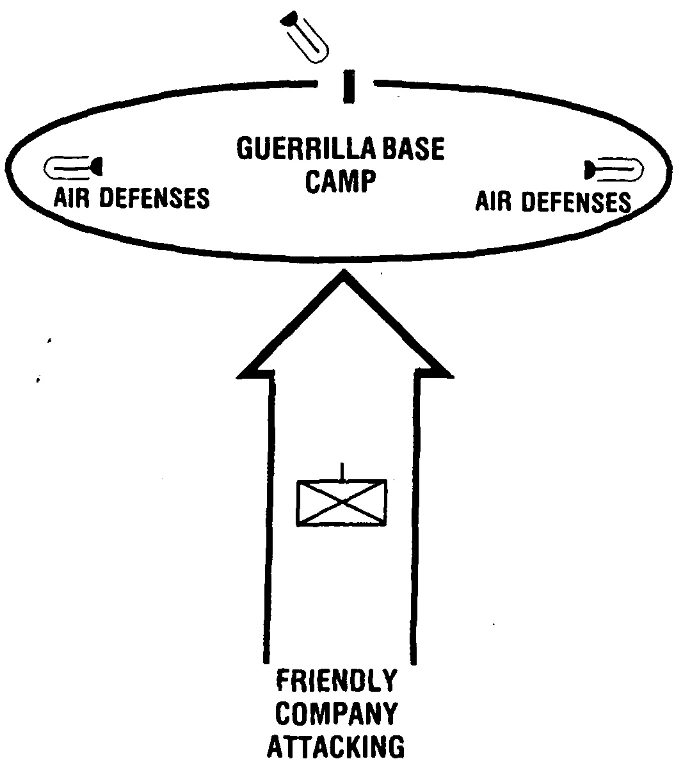


Figure II-11. Central/South America - U.S. Dismounted Attack Against a Guerrilla Base Camp

Table II-4 provides a summary of scenario and tactical situations by phase.

Table II-4. Summary of Scenarios by Phase

Phase of Operational Test Plan	Scenarios/Situations to be Executed
Phase I Modification Decision Test	• Central Europe - U.S. defense at FLOT - U.S. counterattack at FLOT - U.S. rear area combat operation
Phase II Competitive Fly-off Test	• Central Europe - U.S. defense at FLOT - U.S. counterattack at FLOT - U.S. rear area combat operation • Southwest Asia/Middle East - U.S. attack of motorized rifle battalion in tactical march column - U.S. battalion defense against a hasty attack - U.S. battalion counterattack against a hasty defense • Central/South America - U.S. counter-ambush - U.S. defense of a fire base - U.S. dismounted attack against a guerrilla base camp

C. TEST EXECUTION

1. Introduction

To obtain adequate information for addressing the previously described critical operational issues, it will be necessary to conduct field trials, the total number of which has a significant impact on the cost of that test. This section will develop estimates of the total number of trials required for each test. These estimates will be used to scope the expected duration of each test.

The estimates are influenced by assumptions concerning the variables to be controlled during each trial and the methodology to be used in analyzing the collected data. The following discussion first addresses assumptions concerning test control variables. The concept of a test period is then defined and related to test trials. An example of an evaluation methodology, presented here only to facilitate scoping each test, is then described. Given this methodology and additional assumptions concerning expected aircraft performance differences and desired statistical confidence levels in detecting these differences, an estimate of the number of trials required to adequately test each candidate aircraft type is presented. Finally, the expected duration for each of the Phase I and Phase II tests is calculated.

2. Test Control Variables

The following assumptions have been made to enable estimation of the required number of trials. Refinement of these estimates may be required as detailed test planning progresses.

a. Aircraft Type

Phase I includes three aircraft types: the A-10A, an A-7 and the developmental A-16. Phase II could include, in addition to the A-10A and A-16 aircraft tested in Phase I, the A-10C, the AV-8B, the F/A-18 and a Mudfighter, for a maximum of six alternative aircraft. This number will likely be reduced on the basis of information developed prior to the start of Phase II.

b. Weapons and Countermeasures

Weapons and countermeasures to be employed by each candidate aircraft type over the range of tactical conditions to be evaluated will be determined in advance of each test by

the Air Force, the Navy or the Marine Corps. The appropriate Service will provide sufficiently detailed descriptions to the test control authority.

c. Tactical Situations

Three of the nine tactical situations described in Section II.B, those involving a high intensity conflict in Central Europe, will be addressed in the Phase I Modification Decision Test. All nine of the tactical situations will be included in the Phase II Competitive Fly-Off Test.

d. Target Types

Four basic types of targets will be considered in each test: maneuver units predominantly mounted in combat vehicles and moving, participating in offensive action; maneuver units with some elements dismounted and stationary, participating in defensive operations; artillery units in hastily prepared firing positions; and air defense units, both moving and in stationary overwatch positions. Not all target types appear in each scenario.

e. Visibility Conditions

The Phase I test will focus on daylight CAS operations. Night exploratory trials will be conducted in preparation for the Competitive Fly-Off if aircraft and crew training permit. The Phase II test will include both day and night CAS missions, as well as missions during adverse weather if operating conditions permit. Not every Phase II test trial conducted under day conditions will be replicated under night conditions. However, it is expected that approximately 60 percent of the test trials in Phase II would be conducted under conditions of limited visibility (night and/or adverse weather).

f. Aircraft Tactics

The tactics employed by the candidate aircraft during each test will be determined by the appropriate Service prior to the test, and will represent their best estimate of how each aircraft would be employed under the conditions specified in the detailed test design plan. *There is no intent to use these tests to evaluate alternative tactical concepts.*

g. Air Crew Qualifications

Personnel selected to be the air crew members for the proposed CAS test should have equal experience levels and qualifications. They should be representative of fully qualified military air crews.

3. Test Periods and Test Trials

A test period conceptually includes all events from the time two flights each of two CAS aircraft depart the air base until they return to that base. Upon departure, each flight of aircraft sequentially reports to an initial Control Point (CP) where it is contacted by an Air Liaison Officer (ALO). The ALO assigns each flight in turn to a target and to an Initial Point (IP) where contact will be made with a Forward Air Controller (FAC) or appropriate ground force element. Additional information on the target will be provided to the CAS flight. Once the target is attacked, each flight exits the battle area and reports to a second CP, where another target and IP are assigned. This process is repeated until three targets are attacked by both flights, as indicated in Figure II-12, and the flights have exited the battle area for the third time. Once both flights have checked in at CP 4, they are directed to return to the air base and the test period is terminated. Each test period, in essence, corresponds to a single ground battle in which three separate targets are attacked by each of four participating CAS aircraft.

Under the circumstances described in the preceding paragraph, each test period contains three trials. The first trial begins as soon as both pairs of flights have reported arrival at CP 1, and ends when both pairs of flights have reported arrival at CP 2. The second and third trials are defined similarly – covering the times between reported arrival at CP 2 and CP 3, and then between reported arrival at CP 3 and CP 4. Each test trial, in essence, corresponds to a single target being attacked by each of the four participating aircraft.

4. Overview of Analysis Methodology

There are two major issues to be addressed in Phase I:

1. What is the relative capability of the candidate aircraft to destroy specified targets (kill rate)?
2. What is the relative survivability (loss rate) of the candidate CAS aircraft?

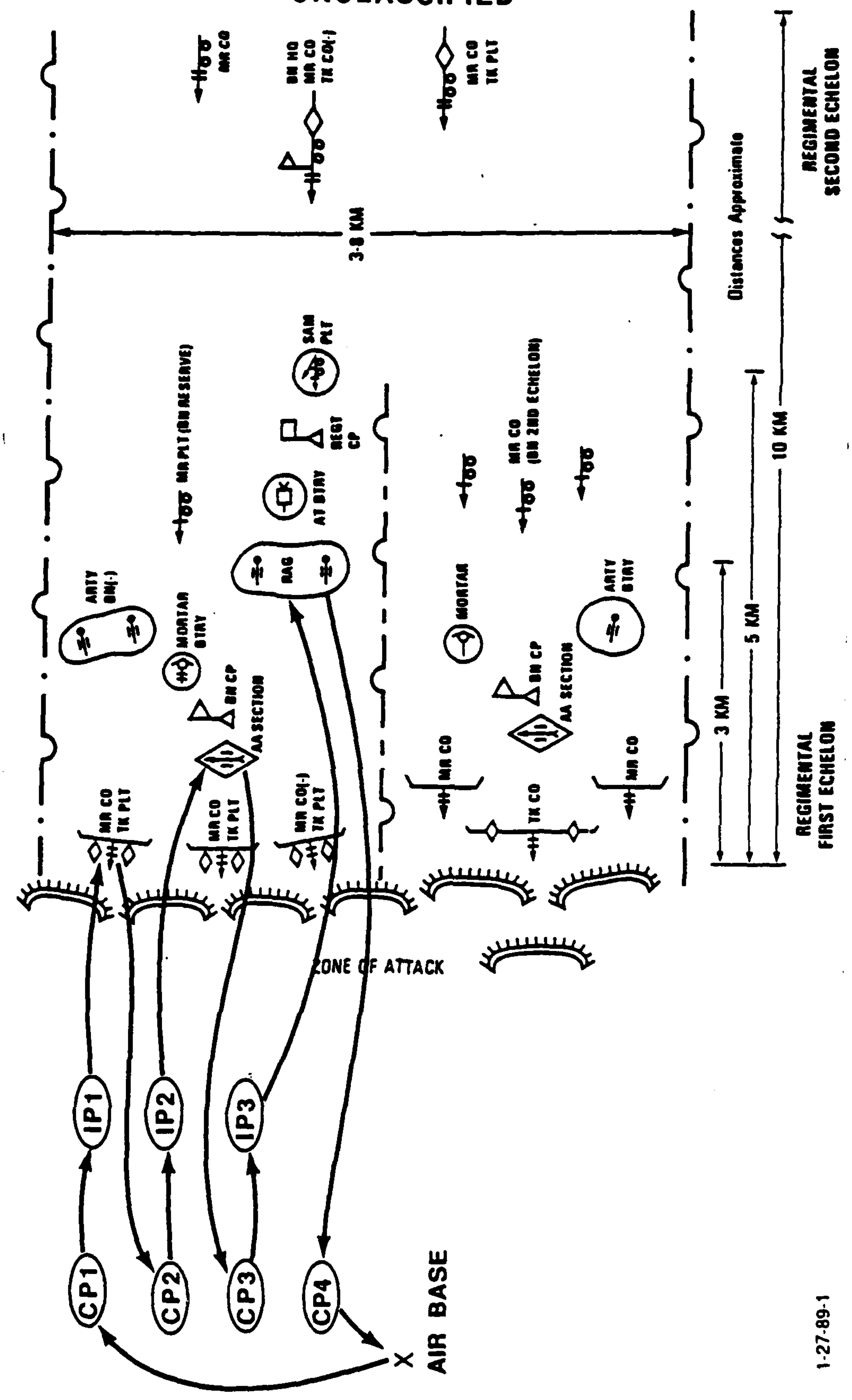


Figure II-12. Test Execution - Multiple Trial Concept

Data will be collected during each test phase to calculate loss rates and kill rates for each type aircraft. For purposes of estimating the number of trials required to discriminate between rates associated with the different CAS alternative aircraft, this section is based on the following assumptions:

(A1) For a given aircraft type, observed kill rates and loss rates will be averaged over all test conditions.

(A2) These average rates will then be used to make pair-wise comparisons between the alternative aircraft types.

(A3) It is important to be able to distinguish between aircraft kill rates and loss rates of the magnitude reported in recent analyses prepared for the CASMARG.

Under these assumptions it can be shown (see Appendix D) that approximately 156 observations per aircraft type are required in order to achieve nominal levels of statistical confidence, i.e., probabilities of Type I and Type II errors each being 0.20.[1] Here, an observation corresponds to a single observed calculated value derived from one trial for a specific aircraft type; all of the 156 observations are averaged in order to determine the observed kill rate and observed loss rate for that aircraft type. The discussion concerning how many observations are obtained during a single trial is provided in Section II.C.5 below.

The analysis concept described in the preceding paragraph was developed solely to facilitate the estimation of required test resources. The actual analytical methodologies ultimately employed will be developed as the detailed test design plan evolves. Appendix D discusses various approaches and methodologies to be examined from two perspectives – compatibility with test conduct and statistical efficiency, i.e., reduction of trial number requirements with little or no sacrifice in the ability to discriminate between alternative CAS aircraft (also see footnote 1).

---

1 Other studies have indicated that the differences in alternative CAS aircraft kill and loss rates are larger than those referred to in Section II.C.4. If assumption (A3) above is modified to reflect these larger differences, then the required 156 observations would provide greater statistical confidence in the test results, i.e., the Type I and Type II error probabilities would be reduced. Alternatively, the same levels of confidence could be maintained while relaxing the requirement for a large number of observations.

5. Test Durations

As previously stated, 156 observations per aircraft type are required in order to achieve nominal levels of statistical confidence. This section assumes that each aicraft participating in a trial provides a single observation.[2] There are to be 4 observations per trial and 3 trials per test period (a total of 12 observations per test period), so 13 test periods would be required to obtain 156 observations of each aircraft type. Assuming that one of every two scheduled test periods is lost due to aircraft, ground manuever, or instrumentation failure implies that 26 attempted test periods would be required. Further assuming that the test schedule prescribes 2 test periods per day and 4 days per week of test activities leads to the conclusion that 13 test days per aircraft type (a test of 3 weeks plus one day per aircraft type) would be necessary to achieve the required number of observations.

Since the Phase I Modification Decision Test examines three alternative CAS aircraft types, the test would require approximately 3 months to complete (factoring in 2 weeks at the beginning dedicated to practice test trials). The Phase II Competitive Fly-Off Test would require 2 to 5 months to complete, depending on the number of candidate aircraft types eventually selected to participate in that test.

D. MEASURES OF PERFORMANCE

1. Introduction

A CAS operational test evaluation plan, developed to support the detailed test design plan, will eventually describe in detail the measures of performance (MOP) that will be used to address the critical operational issues. This set of measures, which must be both meaningful and attainable, will contribute to the assessment of one or more measures of overall aircraft effectiveness in accomplishing the close air support mission.

In preparation for developing the evaluation plan, a preliminary set of measures of performance has been proposed. This set will guide the development of required data elements and the initial assessment of instrumentation requirements. This section identifies

---

2 Appendix D outlines a test procedure for determining if the performance of flight leaders differs significantly from that of wingmen. If the test data support this hypothesis, then it may become necessary to require twice as many total observations (i.e., a test for flight leaders and a separate test for wingmen).

and provides a rationale for this preliminary set of measures of performance. These MOP will:

- Adequately address the critical operational issues and their subissues as identified in Section I. B.
- Provide consistent, but not necessarily identical, measures between phases.
- Provide flexibility and depth in the development of the evaluation plan.
- Guide the development of data and instrumentation requirements.

Two levels of MOP are presented. The primary MOP are those which most directly address each of the issues. They do not always provide a complete understanding of very complex issues. Moreover, the data to compute these primary MOP are not always easily obtained. Especially in Phase I, the requirement to keep instrumentation relatively simple may preclude gathering all of the data required to compute the primary MOP. In those cases, the secondary MOP may allow an understanding of the issue without directly calculating the primary MOP. Another option is to redefine a primary MOP to permit its calculation at a lower resolution with the data available. When primary MOP are used, the secondary MOP add to the understanding of the primary MOP.

a. Definition of Terms

To facilitate the discussion of the measures of performance, some terms need to be precisely defined. Whenever possible, definitions were extracted from or derived from definitions in JCS Publication 1, *Department of Defense Dictionary of Military and Associated Terms*.

- Sortie - An operational flight by one aircraft.
- Flight - A specified group of aircraft engaged in a common mission.
- Pass - A short tactical run or dive by an aircraft at a target.
- Attack - An attempt by a flight to acquire and engage an assigned target concentration. An attack is considered to have commenced when the flight departs the assigned initial point under control of a FAC or ALO to engage the target concentration. The attack ends when the flight completes egress from the target area and is no longer under FAC control or the aircraft are destroyed. A flight may use one or more passes to complete an attack.
- Target - A vehicle, weapon, unit or installation designated to be attacked.
- Target concentration - A grouping of geographically proximate targets.

- Mission - A clear, concise statement of an action to be taken. In this test, the mission will be the designation of a specific target concentration and a level of destruction required from close air support, as requested by the ground commander.
- Successful mission - The achievement of the level of destruction on the designated target that was requested by the ground commander.
- Engagement - The firing of an enemy weapon or release of aircraft ordnance at an acquired target.
- Engagement attempt - The decision to engage a target believed to be in or approaching the engagement envelope of the weapon, whether or not it results in an engagement. An engagement attempt will be defined as a specific point in the engagement sequence for each weapon system in the test.
- Target acquisition - The detection, identification and location of a target in sufficient detail to permit the effective employment of weapons.

b. Measures of Performance

The measures of performance will focus on each of the three CAS requirements described in Figure I-1. These are consistent with the subissues described earlier. An initial set of 15 measures of performance that are sufficient to initiate data requirements, instrumentation and player equipment planning is proposed. The measures of performance which are discussed in the following sections are summarized in Table II-5.

2. Target Acquisition and Engagement Measures

Using the JCS Publication 1 definition, target acquisition requires the detection, identification and location of a target in sufficient detail to permit effective employment of weapons. Thus, detection of a target after passing over it is not sufficient to provide "acquisition." Identification is defined as the process of determining the friendly or hostile character of a detected target.

The complete assessment of this issue will depend on data from other tests of weapons delivery accuracy given specific weapons release parameters and munitions effects. This test will focus on recording the weapons release parameters in a realistic operational environment.

The following measures will be used to assess target acquisition and engagement performance.

Table II-5. Planned Measures of Performance

TARGET ACQUISITION AND ENGAGEMENT	PHASE I	PHASE II
MOP 1 - PERCENT OF SUCCESSFUL MISSIONS [1]	X[2]	X
MOP 1.1 - Percent of aircraft passes with a correct target acquisition	X	X
MOP 1.2 - Percent of passes that engage the target concentration	X	X
MOP 1.3 - Percent of passes that engage friendly ground forces	X	X
MOP 1.4 - Percent of passes without engagement of the target concentration by reason	X	X
MOP 1.5 - Number of sorties per successful mission	X	X
SURVIVABILITY		
MOP 2 - AIRCRAFT LOST PER SUCCESSFUL MISSION [1]	X[2]	X
MOP 2.1 - Aircraft lost per attack	X	X
MOP 2.2 - Air defense engagement attempts per attack	X	X
MOP 2.3 - Air defense engagements per attack	X	X
MOP 2.4 - Percent of air defense engagement attempts defeated by reason	X	X
RESPONSIVENESS		
MOP 3 - AIRCRAFT OPERATIONAL AVAILABILITY [1]		X
MOP 3.1 - Critical aircraft subsystems mean time between failures		X
MOP 3.2 - Critical aircraft subsystems mean time to repair		X
MOP 3.3 - Percent of aircraft not available for CAS by reason		X

[1] Primary MOP
[2] May require a simplified definition of "successful mission" for Phase I

a. MOP 1 - Percent of Successful Missions

This is the first question the ground commander wants answered – can the CAS aircraft accomplish the mission? This MOP is dependent on being able to define a successful mission for each scenario.

Complete computation of this measure requires an accurate assessment of weapon effects on the targets. This may be very difficult to calculate in Phase I. It may be necessary to reduce the definition of a successful mission in Phase I to be any attack in which the aircraft attack the correct target concentration.

b. MOP 1.1 - Percent of Aircraft Passes with a Correct Target Acquisition

This measure reports directly how successful the aircraft is in acquiring targets in such a manner as to permit effective engagement. It also gives insight about how the aircraft exposes itself to danger without finding a target to engage. It should help quantify the value of various target detection and target handover systems and may help assess the impact of aircraft speed and tactics on mission performance.

Measuring correct target acquisition requires not only some indication from the aircraft that an acquisition has occurred, but also a confirmation that the correct target was acquired.

This secondary measure of aircraft effectiveness addresses what many believe to be the key element of providing close air support – the ability to acquire the correct target. Calculation of this measure will require data to verify that the aircraft has correctly acquired the target. This will include targets acquired and not engaged and will exclude targets attacked even though the aircraft did not have a positive acquisition and identification of both the target and nearby friendly forces.

c. MOP 1.2 - Percent of Passes that Engage the Target Concentration

This is a measure of the aircraft ability to continue the attack beyond acquisition to target engagement. Since the concern is how to measure weapon delivery effectiveness, a determination is desired not only of whether or not the target was acquired and engaged but also whether the engagement was likely to result in some effect on the target. A target kill-probability is desired, but an assessment that the probability of a kill is greater than zero would, in itself be a useful discriminant.

d. MOP 1.3 - Percent of Passes that Engage Friendly Ground Forces

This is a measure of the inability of the aircraft to distinguish friendly from enemy targets or to deliver ordnance accurately enough to avoid casualties to friendly forces.

e. MOP 1.4 - Percent of Passes Without Engagement of the Target Concentration by Reason

This measure identifies why aircraft pass over the target area without producing an effect on the target. The full list of reasons will probably not be defined until after the test, but they should include the following:

- No target detected or acquired.
- Target acquired outside weapons delivery envelope.
- Target detected too late or too far off the line of flight to engage.
- Unable to avoid friendly forces.
- Unable to determine danger to friendly forces.
- Forced to abort due to air defense radar lock on.
- Forced to abort due to enemy fires.
- Inaccurate ordnance release.

f. MOP 1.5 - Number of Sorties per Successful Mission

This measure should give an indication of how efficient each type of aircraft is in accomplishing the CAS mission once in the battle area. This measure requires that ground force casualties from air attack be calculated.

3. Survivability Measures

The following measures of performance will be used to assess the relative survivability of the candidate aircraft.

a. MOP 2 - Aircraft Lost per Successful Mission

This measure addresses directly the cost, in terms of lost aircraft, to accomplish the missions the ground commanders are requesting.

This measure requires, prior to the test, a precise definition from the requesting organization of what is required to accomplish the CAS mission. This definition may take several forms such as the destruction of a certain number of enemy vehicles, possibly

within a given period of time or before the enemy force reaches a specific location. To reduce the sensitivity of the measure to the definition and to ensure partial success and overkill are accounted for, computations of this measure should allow for fractional mission accomplishment.

b. MOP 2.1 - Aircraft Lost Per Attack

This measure will help to explain the effect of differing tactics, weapons and aircraft effectiveness. Since the number of passes per attack may vary by aircraft, this measure shows the cost, in terms of aircraft lost, of attempting to attack a target concentration.

c. MOP 2.2 - Air Defense Engagement Attempts per Attack

This is a measure of the susceptibility of the aircraft to acquisition and engagement by the enemy air defense. It is an upper limit estimate of the number of engagements that might occur in these conditions. An engagement attempt may or may not result in an engagement. An engagement attempt will be defined at a specific point in the engagement sequence for each system in the test.

d. MOP 2.3 - Air Defense Engagements per Attack

This measure adds to the previous measure. It is the number of trigger pulls by weapon type against aircraft for each aircraft attack. This measure should give some insight as to which aircraft characteristics and tactics are stressing the capabilities of the air defense systems.

e. MOP 2.4 - Percent of Air Defense Engagement Attempts Defeated by Reason

This measure further expands the understanding of survivability by categorizing the reasons why air defense engagements fail. This measure will only apply to engagements that result in a kill probability of zero. The full list of categories may not be developed until the test has been run, but as a minimum a count is required of the following:

- Aircraft track departed the engagement envelope before impact.
- Aircraft countermeasures defeated air defense system guidance.
- Aircraft took evasive action.
- Air defense system reliability failure.
- Air defense system killed or suppressed during engagement sequence.
- Aircraft hit but survived.
- Aircraft remasked behind terrain.
- No engagement during this engagement attempt.

4. Responsiveness

While responsiveness is affected by many factors, the only data from these tests that address responsiveness will be in the area of operational availability. Within this one category, use will be made of already existing operational reliability, availability and maintainability (RAM) data bases on current aircraft. The test focus will be on identifying indicators of potential RAM performance in candidate aircraft and integrated systems. These indicators will assist in focusing test issues in future operational tests and evaluations of the selected candidate. Responsiveness will not be tested in Phase I.

Measures of performance for RAM will follow traditional lines and will include as a minimum the following:

a. MOP 3 - Operational availability of the aircraft.

b. MOP 3.1 - Mean time between failures for critical aircraft subsystems.

c. MOP 3.2 - Mean time to repair for each of the critical aircraft subsystems.

d. MOP 3.3 - Percent of aircraft not available for CAS by reason.

E. DATA REQUIREMENTS

1. Introduction

This section describes the data required to compute the measures of performance. The data elements are described in sufficient detail to allow cost and schedule estimates for instrumentation and data processing. While it would be desirable to collect all Phase II data in Phase I also, data for Phase I has been tempered by cost and instrumentation feasibility considerations.

2. Data Types

Three classes of data will be recorded: static data, time/space/position indicator data (TSPI), and event data.

a. Static Data

Static data are the information that will not change during the trial, and that describes the conditions of test and provides identifiers for data base management of all collections. Static data elements describing scenario and other test conditions will be recorded for each player and trial. Player descriptive data will include player identification, instrumentation configuration, weapons, munitions load, crew identification, and system and instrumentation anomalies. Trial data will identify the test conditions including weather, scenario, players included in the trial, trial start and stop times, mission orders and a written description of the trial conduct.

b. TSPI Data

Data are needed to calculate a number of the MOP and are important for post trial reconstruction of what occurred during a trial. Player location is needed in x, y, and z. Ground player z may be based on digetized terrain data base information. Aircraft attitude and acceleration information may be required for casualty assessment calculations for both ground-to-air and air-to-ground engagements. Player location requirements will vary by player type and test phase. Accuracy will also depend on the sophistication of the casualty assessment methodology being used in each phase. Very sophisticated methodologies may require less accuracy. "Brute force" methodologies require greater accuracy.

c. Event Data

Event data describes significant events and changes in the status of players during the test that relate to the measures of performance. All events are time tagged to a common reference. Of particular importance are those events which describe the target detection and engagement sequences and those related to casualty assessment. Aircraft availability and repair information will also be included in this category.

3. Data Elements by Measure of Performance

Table II-6 lists the data elements required to compute each of the measures of performance. Data will be tagged by trial, scenario, attack aircraft and threat weapon type.

Table II-6. Data Elements and Measures of Performance

REQUIRED DATA	MEASURE OF PERFORMANCE																
	1	1.1	1.2	1.3	1.4	1.5		2	2.1	2.2	2.3	2.4		3	3.1	3.2	3.3
AIR-TO-GROUND ENGAGEMENT DATA																	
Aircraft identification	X	X	X	X	X			X									
Aircraft flight path	X	X	X	X	X			X									
Aircraft attitude	X		X	X				X									
Aircraft velocity and acceleration	X		X	X				X									
Aircraft system status	X		X	X				X									
Aircraft pass start/stop time		X	X	X													
Aircraft attack start/stop time								X	X	X	X						
Time ground target detected		X															
Classification of detected ground target		X															
Pilot ID of detected ground target		X															
Actual ID of detected ground target		X															
Target engagement time	X		X	X				X									
Weapon type	X		X	X				X									
Ground target ID	X		X	X				X									
Ground target location	X		X	X				X									
Weapon delivery parameters	X		X	X				X									
Aircraft parameters at weapon launch	X		X	X				X									
Ground target countermeasures	X							X									
Scoring of ordnance delivery	X		X	X				X									
Weapons effect assessment	X							X									
Defined CAS mission	X	X	X					X									
Reason for not engaging					X												
Radar warning receiver activity					X												

Table II-6. Data Elements and Measures of Performance (Cont'd)

REQUIRED DATA	MEASURE OF PERFORMANCE																
	1	1.1	1.2	1.3	1.4	1.5		2	2.1	2.2	2.3	2.4		3	3.1	3.2	3.3
GROUND-TO-AIR ENGAGEMENT DATA																	
Air defense weapon ID								X	X	X	X	X					
Air defense weapon location								X	X	X	X	X					
Weapon type								X	X	X	X	X					
Air defense system status								X	X	X	X	X					
Target aircraft ID								X	X	X	X	X					
Target aircraft countermeasures status								X	X			X					
Time air target detected										X							
Classification of detected air target										X							
Air defense ID of detected air target										X							
Actual ID of detected air target										X							
Air defense engagement time								X	X	X	X	X					
Engagement mode								X	X	X		X					
Air defense tracking of aircraft								X	X	X		X					
C3 countermeasures status								X	X			X					
Scoring of defense engagement								X	X			X					
Reason for not engaging aircraft												X					
RELIABILITY DATA																	
Time aircraft launched/recovered														X	X		
Aircraft system failure time														X	X		
Time location to repair														X		X	
Identification of failed system																X	X

F. INSTRUMENTATION

1. Introduction

This section describes the instrumentation required to collect the data discussed in the previous section. Instrumentation requirements include position location, event and environmental recording. This section focuses on generic system types to support preliminary test planning rather than identification of specific instrumentation systems. This discussion demonstrates the feasibility of collecting the required data; however, alternative instrumentation systems may be identified during detailed test planning. Engagement pairing and firing signature devices are covered in this section also.

2. Overview

Instrumentation will record, within a common grid, approximate ground and air player locations as a function of time. Event data related to time and player position, is also needed to determine mission-related activity as well as to determine and assess the results of hostile air defense engagements and friendly CAS attacks. Additional systems can provide instantaneous pairing (shooter/victim) of engagement and attack interactions in real time, if the pairing instrumentation is coupled into the range reference system (RRS) instrumentation. Without pairing instrumentation, pairing can be accomplished in post-trial analysis.

If the test design is tailored to post-trial assessment of engagements, the sophistication of required instrumentation and associated data processing equipment is slightly relaxed.

In addition to the methods described above, event data can be recorded by time-tagged video/audio recorders, electronic clipboards, cameras, and by hand on manual forms as both primary and secondary means of data collection. As much as possible, the instrumentation must be transparent to the test players.

3. Phase I Instrumentation

This section describes a generic range reference system (RRS) and player system instrumentation needed to support Phase I.

a. General

Phase I test instrumentation will be designed to accommodate post-trial pairing and limited firing signature and engagement cueing. It will provide reasonable post-trial kill assessment information and limited post-trial feedback to players. In addition, the experience of the Phase I test will help identify requirements for the improvement, implementation, and checkout of instrumentation for the Phase II test.

Ground-to-ground player pairing may be accomplished through MILES equipment to drive realistic player actions; engagement results will not be recorded.

b. Range Reference System (RRS)

A multilateration range reference system can provide player x, y, and z position location information as a function of time. No attitude data will be available for aircraft players in real time. Radar altimeter data availability will depend on the type of RRS selected and associated aircraft pods. Aircraft flight paths will be generated post-trial from raw TSPI data using coordinated flight path and smoothing routines.

None of the event data associated with air or ground players will be integrated to the RRS. Pairing will be accomplished post-trial.

c. Player Instrumentation

(1) CAS Aircraft

CAS aircraft will be equipped with equipment to record over-the-should heads up display (HUD) or attack display for the flight. Events will be integrated into the RRS post-trial. This instrumentation will be augmented by manual forms completed during pilot debriefings and by data collector/observers deployed in the field. Attempted attacks, attacks with successful delivery, assigned targets, and similar data collected from the pilots and the observers will aid the assessment of air-to-ground attacks.

Pairing of air-to-ground attacks will be augmented by data collectors/observers stationed at strategic locations within target concentrations. These data collectors will observe and record time, aircraft heading, and the target concentrations attacked by CAS aircraft. By correlating pilot, field observer, attack video/audio, flight path data, and target array data, attacks will be paired to proper target concentrations.

Paired attacks that meet delivery requirements will be recorded with respect to type munition, range at launch, type target, target aspect, and target status.

Software that projects the flight path data along the ground player array at time of launch will assist analysts in making air-to-ground assessments. Airspeed, altitude, target range, and attitude information from video recorded data will further enhance this process. Weapon effects assessments will be made during post-trial analysis using Joint Munitions Effectiveness Manual (JMEM) and associated data.

(2) Friendly/Hostile Targets

The ground force will consist of tanks, armored fighting vehicles, air defense artillery command and control nodes, air defense fire units, artillery, and others as applicable. Special additional considerations for the hostile air defense units are discussed below.

Targets may be instrumented for TSPI data, but no heading information will be provided for target type players. All ground players will have firing signature devices linked to launch/fire switches to add realism to the test. No cueing information will be provided to targeted ground players being "launched at" since aircraft launch/fire signals will not be integrated to the RRS. Maneuver command and control vehicles may be equipped with audio recorders to provide additional information.

(3) Hostile Air Defense Threat Systems

Substantial manual intervention will be required in the preparation, pairing and determination of conditions for fly-outs.

Command and Control (C^2) Nodes. With the exception of firing signature devices, hostile air defense C^2 nodes will be equipped similarly to other targets. In addition, these players will be equipped to collect digitally data-link message, operational event and tracking data. This instrumentation will not be integrated with the RRS. A time-tagged, over-the-shoulder (OTS) video/audio device recording the radar surveillance presentation will also be employed. Test force observers with manual data collection forms will also be present at the nodes.

Radar Fire Units. Hostile radar fire units will be equipped the same as other targets. In addition those units will be instrumented to accommodate their air defense functions. These additions include digital recording of message traffic and event/tracking data applicable to the fire unit's activity, video/audio boresight recorders, mode, trigger pull, lock-on times, launch signal, launch signature devices and manual data collection. None of this instrumentation will be time tagged into the RRS.

Using fire unit tracking data at key events and flight path data associated with each of the participating CAS aircraft, the post-trial processing system will provide pairing information for ground-to-air engagements. Information from radar fire unit trackers in azimuth, elevation, and range can be merged with TSPI flight path data provided by the RRS to enhance CAS aircraft vertical position data.

Flyouts may be run against the paired flight path data provided by the RRS and augmented by the options proposed above. Actual tracking of the target in real time by the operators will not influence the results of the flyout in Phase I. However, data observed from review of video and listings of threat fire unit switch positions will influence the results if the flyouts are run under the presence of jamming or chaff.

Infrared (IR) Fire Units (Crew Served). Crew served, hostile IR fire units will be instrumented similarly to the radar fire units. Only a limited amount of tracking data is available from these types of units; however, pedestal readings of azimuth and elevation will be available from these systems for recording as a function of time. Pointing data from the fire unit and correlation to CAS aircraft flight path should provide some automatically paired ground-to-air IR engagements. In instances where flares are observed, their effects will be played in flyout models.

IR Man-Portable Air Defense Systems (MANPADS). Man-portable, IR fire units will be the most difficult to assess. Where possible, these units will be treated similarly to the other fire units. Positions for MANPADS can be established relative to the vehicle to which they are assigned by using azimuth and range relative to the vehicle. The position of the vehicle and, thus, the MANPADS would be known through the RRS. MANPADS position and event data will have to be supported by a data collector/observer, who can determine at launch the approximate heading of the paired target aircraft. This information can be correlated to the video/audio instrumentation of the MANPADS, flight path data, etc., to establish pairing and to run flyouts.

4. Phase II Instrumentation

a. General

Phase II test instrumentation will be similar to Phase I, but it will be improved in sophistication, accuracy and reliability. Pairings will be accommodated in real time by lasers, affording near real time knowledge of shooter/victim interactions. Casualty assessment information can be sent by the RRS to the targeted player. Real time firing

signatures for aircraft as well as ground players will be researched, and realism of the test should be substantially improved.

Threat air defense systems will be oriented and brought into the RRS reference grid. With proper calibration, this technique can be used to determine miss distance at intercept of flyouts using actual threat tracking and RRS TSPI data. This should be a considerable improvement from Phase I, where flyouts are flown against the TSPI data and actual tracking is not modeled.

With the real time pairing capability, much more responsive and reliable data will be provided for feedback to the players. Firing signatures, cueing and improved feedback should add much to the realism and competitiveness of trial participation by the players.

Phase II instrumentation will consist of all Phase I instrumentation plus the additions discussed below. An interactive ground battle will also be played.

b. Range Reference System (RRS)

Range reference system TSPI will be improved for Phase II by the addition of multiple pods, aircraft attitude, and the radar altimeter for aircraft participants. The addition of aircraft attitude provides an option for further improvement to the post-trial flight path smoothing algorithm and algorithms to pair and assess direct and indirect air-to-ground attacks.

Post-trial transformations to bring threat air defense participants into the reference grid should improve overall ground-to-air pairing and assessment accuracy. Flyout models will be flown and assessments will be made based on the tracking performed during the test.

c. Player Instrumentation

(1) CAS Aircraft

Phase II additions to the CAS aircraft include attitude, radar altimeter, multiple pod carriage in the area of TSPI laser transmitters and laser detectors for near real time pairing, and devices to cue the pilot when fired on. In addition, jammer, chaff and flare activation (on/off) switches will be instrumented. All these functions will be integrated into the RRS.

Video/audio attack recorders will be retained to verify achievement of required attack delivery parameters and for backup. Scoring will be accomplished in a manner

similar to that described for Phase I, but with additional utility software support in the area of pairing and assessment.

(2) Friendly/Hostile Target

Phase II improvements for these types of players include heading information, improvements to firing signature devices, and light/tone devices to cue the operators when engaged. All will be integrated into the RRS. These systems will be instrumented to pair and kill in real time by the addition of laser pairing devices and lookup tables.

Tank and AFV automatic weapons will have laser transmitters integrated into the RRS.

(3) Hostile Air Defense Threat Systems

C^2 Nodes. Phase II instrumentation for these test participants is similar to other targets and will be essentially the same as Phase I. Exceptions include the integration of player instrumentation to the RRS, the addition of a light/tone "launched at by" cue, and the possible addition of more descriptive events. These will be integrated to the RRS.

Radar Fire Units. Hostile radar fire units will be equipped similarly to the targets plus the addition of laser pairing devices. Based on findings of Phase I, additional descriptive events may be added to the radar fire unit list. All digital system information will be integrated to the RRS.

Pairing and assessments of ground-to-air engagements should be much improved with Phase II instrumentation. Backup instrumentation will be retained to support any reconstruction needs due to primary instrumentation data loss/contamination problems.

IR Fire Units (Crew Served). Crew served, hostile IR fire units will be instrumented similarly to the radar fire units.

IR MANPADS. It will be difficult to integrate the MANPADS into the RRS. Position may be automated by use of a portable TSPI unit. A bearing indicator can be aligned to the fire unit for direction as a function of time. A laser transmitter will be added to the MANPADS, but integration into the RRS is to be determined. Video/audio recordings and manual backup will remain a substantial part of the MANPADS instrumentation for Phase II.

5. CAS Test Instrumentation Summary

The goal is to implement some of the Phase II instrumentation during Phase I. As a minimum, Phase I instrumentation will be implemented as described in Section II.F.

For Phase II, numerous instrumentation components will be integrated into the RRS for data collection with TSPI in real time. Many of these instrumentation components are equipped with digital recorders, providing a backup to the RRS.

Instrumentation for Phase I and Phase II is summarized in Tables II-7 and II-8, respectively.

Table II-7. Phase I. Test Instrumentation

Instrumentation/Player Equipment \ Player Type	CAS Aircraft	Targets[1]	ADA C2	Radar Directed ADA	Crew Served IR ADA	MANPADS ADA
Range Reference System	X	X[2]	X	X	X	X
Radar Altimeter	X					
HUD Recorder	X					
Digital Message/Events Recorder			X	X	X	X
Audio Recorder	X		X	X	X	X
Video Recorder	X		X	X	X	X
Boresight Video Recorder				X	X	X
Audio/Visual Radar Recorder			X	X		
Pedestal Azimuth Elevation Recorder					X	
Observer/Data Collector	X[3]	X	X	X	X	X
MILES		X		X[4]	X[4]	X[4]
Firings Signature Devices		X		X	X	X

[1] Targets include friendly and hostile tanks, armored fighting vehicles, C2 sites, artillery and field trains.

[2] RRS may only be required for center of mass of target concentrations.

[3] No observers on the aircraft. Field observers and post-flight debriefers will collect aircraft manual data.

[4] MILES sensors required for air defense units positioned where hostile ground forces could engage them with direct fire weapons.

Table II-8. Phase II. Test Instrumentation

Instrumentation/Player Equipment \ Player Type	CAS Aircraft	Targets[1]	ADA C2	Radar Directed ADA	Crew Served IR ADA	MANPADS ADA
Range Reference System	X	X[2]	X	X	X	X
Radar Altimeter [5]	X					
HUD Recorder	X					
Inertial Navigation System[5]	X					
Laser Pairing System[5]	X	X	X[4]	X	X	X
Digital Message/Event Recorder [5]	X[6]		X	X	X	X
Audio Recorder	X		X	X	X	X
Video Recorder	X		X	X	X	X
Boresight Video Recorder				X	X	X
Audio/Visual Radar Recorder			X	X		
Observer/Data Collector	X[3]	X	X	X	X	X
Firings Signature Devices[5]	X	X		X	X	X

1 Targets include friendly and hostile tanks, armored fighting vehicles, C2 sites, artillery and field trains.

2 RRS may only be required for center of mass of target concentrations.

3 No observers on the aircraft. Field observers and post-flight debriefers will collect aircraft manual data.

4 Laser receivers only required.

5 Intcgrated to RRS.

6 Includes aircraft countermeasures such as chaff, flares, jamming o.i/off.

CHAPTER III
TEST AND EVALUATION RESOURCE SUMMARY

CHAPTER III
TEST AND EVALUATION RESOURCE SUMMARY

A. INTRODUCTION

The purpose of this chapter is to present estimates of the support needed to plan and conduct the CAS operational tests described in Chapter II, and of the funds required to secure that support. The support required generally falls into several categories:

1. The magnitude and type of the ground forces needed to create the proper CAS operating environments.
2. The number of CAS aircraft, by type, that will participate in the test, and the number of flying hours associated with each aircraft.
3. The location of the test site and the air base from which the CAS aircraft will operate.
4. The instrumentation and automatic data processing (ADP) support required.
5. Other test support equipment, such as threat surrogates and kits designed to modify visually the appearance of selected items of equipment.
6. The size and origin of the test control organization.
7. The use of analysis, including simulation and man-in-the-loop simulators, to support selected test activities.

In the following paragraphs each of these topics will be developed in sufficient detail to facilitate preparation of rough estimates of the costs of both the Phase I Modification Decision Test and the Phase II Competitive Fly-Off Test. In view of the greater uncertainty associated with the latter test, e.g. number of candidate aircraft, test schedule, duration of test, location of test site and instrumentation and ADP support required, subsequent discussions will focus primarily on the earlier Modification Decision Test. An extrapolation will then be made to provide preliminary indications of the likely range of costs of the Phase II Competitive Fly-Off Test.

B. GROUND FORCE PLAYER SUPPORT

The purpose of this section is to estimate the size and type of friendly and enemy ground forces required to support the operational tests previously described. The results obtained will be used to identify troop support requirements, to include the forces, equipment and training anticipated, and subsequently the costs associated with providing that support. The tactical situations used in the following discussion are those described in Section II.B.

1. Methodology

The methodology used to size the ground forces, both U.S. and enemy, needed to support the Phase I and II tests consists of two steps.

First, the tactical situations described in Section II.B were reviewed and separated into sets of situations that required about the same total (U.S. and enemy) force commitment. Second, a detailed force description was prepared for a representative situation from each set of situations identified in the first step. This procedure precluded having to develop detailed force descriptions for each of the nine tactical situations to be tested, while still providing adequate estimates for these preliminary costing purposes.

2. Required Ground Forces

As a result of the review of the nine tactical situations, two sets were established: the first includes those situations associated with the Central Europe and Southwest Asia/Middle East scenarios; the second set includes the three Central America/South America situations.

a. Set # 1: Central Europe and Southwest Asia/Middle East

These situations generally involve large, multi-battalion, mechanized and armor forces, with appropriate levels of artillery, mortar and air defense support. The Central Europe FLOT defense situation was selected as most representative of an upper bound on force requirements for this set of situations. Table III-1 provides a summary of the U.S. and enemy forces and equipment required to replicate this situation in a test environment. Only major items of equipment are listed for each force element. The threat equipment listed is provided for illustrative purposes only. Threat equipment actually employed in the test will be representative of that anticipated to be fielded in the mid-1990s.

Table III-1. Illustrative Forces for U.S. Defense at FLOT

Situation One (1)

Enemy Force		U. S. Force
Enemy Players to be Simulated	Enemy Surrogate Players for the Test	U. S. Defense* Players
2 Motorized Rifle Bn (Reinf) 5 Motorized Rifle Cos (each) 10 (50) Armd Pers Carr (BMPA) 2 (2) Armd Comd Veh (BTR60) 2 (2) Armd Sct Car (BRDM-2)	2 Mech Inf Bn (Reinf) 3 Mech Inf Cos 50 TOW APCs 2 Carrier CP M-577 2 M-113 (w/o TOW)	Mech Inf Bn/TF (-) 1 Bn Tac CP 6 ITV 1 Mech Inf Co 12 BFV
2 Tank Co 6 Tank Plat (each) 4 (24) Tanks (Tank Type T-72) 16 Vehicles (misc) (trucks, recov refuel, amb) 2 BTR-60	2 Tank Co 6 Tank Plats 4 (24) Tanks, M-60 (Viz Mod) 16 Vehicles - misc (52-1/2 trucks, recov, refuel, amb) 2 M-113	1 Tank Plat 4 M1 1 Attack Hel Co 3 AH-64 2 OH-58
Antitank Btry (ATGM) (-) 2 Plat (each) (2 Armd Sct Car) 3 (6) BRDM-2s SAGGER 1 (2) BRDM Sct Car 3 (6) Trucks (Ammo) 1(1) BRDM-2 (Btry Cdr)	2 M-114/113s 6 TOW APCs 2 M-114/113s 6 Trks, Ammo 2-1/2T 1 M-114/M-113	1 Btry Arty
Artillery Bn (Reinf) 3 Btrys (each) 6 (24) Howitzer (122mm) 2 (8) ACRVs (Arty C&R Veh) 2 ACRVs (Bn Hq) 1 (4) BMPs (Surv) 6 (24) Trucks (Cargo, Recov, Amb, Refuel)	24 Howitzers (155 How) 8 M-577s 2 M-577s 4 M-114s/M-113 24 Trucks (4 Recov, 4 Refuel, 4 Amb 12-2-1/2 T Trks) Note: Visual modification kits should be employed on all possible vehicles	*These U. S. units are assumed to be equipped according to existing Modified Tables of Organization and Equipment (MTOE)

Table III-1. Illustrative Forces for U. S. Defense at FLOT (Cont'd)

Situation One (1) (Cont'd)

Enemy Force		U. S. Force
Enemy Players to be Simulated	Enemy Surrogate Players for the Test	U. S. Defense Players
Mortar Btry (122mm) 2 Plats (each) 3 (6) Mortar Carriers 1 (2) ACRVs (Plat Cdr) 2 (2) ACRVs (Btry Hqs) 6 (12) Trucks (Cargo, Amb, Refuel)	6 2-1/2T Trks w/mortars 1 M-114/M-113 2 M-114/M-113 12 Trucks (Cargo, recov, Amb, Refuel)	
Air Defense 14 SA-7/14 Fire Units 4 ZSU-23-4 Fire Units 2 SA-9 Fire Units 3 S-60 plus 1 Radar *2 SA-8s Fire Units *2 SA-6s Fire Units 2 ACRV Cmd Veh	14 Replicas (SA7/14) or Trainers 4 ZSU-23-4 Fire Units 4 CHAPARRALs 3 M42 Duster + 1 Radar 2 ROLAND II or RAPIER 1 Hawk Fire Unit (Base Platoon) 2 Carriers M-577	
1 Reqt CP 2 CP Vehicles 6 Trucks (Pers, Amb, Cargo, Commo)	1 Bde TAC CP 2 CP Veh M-577 6 Trucks (Pers, Amb, Cargo, Commo)	

* To be located in Division Rear area at a realistic distance from the FLOT for full air defense play.

The enemy force described in Table III-1 includes two battalions of a motorized rifle regiment, each consisting of five motorized rifle companies and two tank companies, with an appropriate slice of antitank, artillery, mortar and air defense support. In addition, a regimental command and control element is provided to exercise necessary control over the two battalions and their supporting arms. The U.S. force, on the other hand, includes elements of a mechanized infantry battalion task force, reinforced with an attack helicopter company and a tank platoon.

Achieving the force levels described in Table III-1 would require fielding a heavy brigade of three mechanized infantry battalions and one tank battalion, a reinforced artillery battalion of four firing batteries, an attack helicopter company and a composite air defense battery. These same forces would provide adequate resources to support the remaining five tactical situations included in this set of situations, e.g., the two remaining Central Europe situations and the three Southwest Asia/Middle East situations.

b. Set # 2: Central America/South America

The situations contained in this set require significantly different forces, both in terms of their size and type, than those in Set # 1. The U.S. and enemy forces deployed in the three Latin America situations are dismounted infantry with only limited indirect fire and air defense support.

The specific tactical situation selected as the basis for sizing the total force requirement for this set of situations is the U.S. defense of a fire support base. Table III-2 provides a summary of the major force elements needed to replicate this situation. The attacking irregular force consists of a dismounted infantry battalion, of three infantry companies, supported by a platoon of mortars and a section of man-portable SAM. The defending U.S. force consists of an artillery battery, secured by a dismounted infantry company and a supporting mortar platoon. This force would be more than adequate to supply the forces needed to replicate the remaining two situations in this set, e.g., the counter-ambush and the U.S. attack against a guerrilla base camp.

Table III-2. (U) Central/South America - U. S. Defense of a Fire Base

Situation Eight (8)

Enemy Force		U.S. Force
Enemy Players to be Simulated	Enemy Surrogate Players for the Test	U. S. Defense Players
1 Infantry Battalion (dismounted) 3 Rifle Cos 1 Mortar Platoon 3 SA-7/14 Teams	1 Infantry Battalion (Dismounted) 3 Rifle Cos 1 Mortar Platoon (81 mm) 3 SA-7/14 Teams	1 Infantry Company 1 Artillery Battery 1 Mortar Platoon

3. Other Considerations

a. Command and Control

The importance of responsive command and control of player units and personnel cannot be overemphasized. This is especially true of the enemy force from which CAS targets are selected. Previous experience has proven that unit performance is enhanced when units are employed in their normal organizational structure rather than through the use of a series of individual taskings to various units to meet test troop requirements. In this plan every effort has been made to emphasize that unit integrity.

b. Threat Air Defenses

The primary threat to attacking CAS aircraft may well not be from systems in the immediate target array in the mission request submitted by friendly forces. Because of the enemy air defense concept of protecting forward combat forces with both local and area air defense systems, particularly in Central Europe, friendly CAS might well be most vulnerable to the area coverage systems. For this reason, threat air defense system requirements include those systems peripheral to the targeted elements.

c. Threat Vehicles

Threat vehicles can be represented using one or more of several different methods. These include, in their order of preference:

1. Actual enemy equipment.
2. Authentic replicas of enemy equipment.
3. Surrogates of enemy equipment, such as U.S. or non-U.S. systems, with similar operational characteristics.

In selecting an appropriate surrogate for a system, both operating capability and signature effects, e.g., visual, infrared, must be taken into account. A technique used in several recent operational tests to achieve realistic visual effects employs visual modification (Vis-Mod) kits which are overlaid on selected vehicles. An example is a Vis-Mod kit applied to a utility type of wheeled vehicle with sufficient off-road mobility to represent an enemy tank. The former is considerably more economical to operate than the latter, and may be appropriate if the modification does not interfere with the system's performance during the test. For example, a Vis-Mod can be applied to a U.S. air defense system, making it a surrogate and distinguishing it from like U.S. systems participating in the test. However, the Vis-Mod must not interfere with the surrogate's ability to acquire

and engage attacking aircraft. Vis-Mods will be used in the tests described in this report to the extent that they add to the realism of the test and the quality of the results obtained. Kits will also be used to modify infrared signatures of surrogates where necessary and feasible.

4. Summary

The forces described in Table III-1 are sufficient to meet the needs of all three tactical situations associated with the Phase I Modification Decision Test, and six of the nine situations associated with the subsequent Phase II Competitive Fly-Off Test. The forces described in Table III-2 are adequate to meet the needs of the remaining three tactical situations in the Central America/South America scenario of the Phase II test. These force estimates will be used in subsequent discussions of funding requirements.

C. TEST ARTICLES

1. General Considerations

This test concept includes a Phase I Modification Decision Test that examines the desirability of modifying the current A-10 and F-16. This would be followed by a much more extensive Phase II Competitive Fly-off Test involving aircraft selected from Phase I and possibly other aircraft as well.

The configuration of candidate aircraft in the Phase II Competitive Fly-Off Test has become more critical because of the Tactical Air Command's new concept for CAS in which an aircraft might make a single high-speed, low-altitude attack pass at a target whose position has been sent electronically by a ground or heliborne controller. This concept, which is the Air Force response to growing concerns over survivability and communications jamming, as well as target hand-off during night and other adverse conditions, depends on the successful development and integration of avionics for accepting these targets and weapons for attacking them. Aircraft without these capabilities are likely to perform quite differently from those equipped with the advanced systems, so avionics/fire control integration may be as important as airframe and engine performance features.

The following information was, in the main, generated by manufacturers and program officials and collected in response to the ongoing CASMARG study activities, and is subject to change as results are refined.

2. Phase I, Modification Decision Test Articles

This test is designed to determine the performance capabilities of the current CAS aircraft, the A-10, and to evaluate the desirability of modifying the A-10 and F-16. The following discussion provides a description of the avionics and weapons anticipated to be carried by each of the test articles in the Modification Decision Test.

a. Avionics

Communications between the CAS aircraft and other aircraft in the flight, Wild Weasels, CAP/escorts, surveillance aircraft and traffic control agencies would normally be via HAVE QUICK radios, while interoperability with ground forces (including FAC/FIST) would be through HAVE SYNC which is the aircraft version of the Army's SINCGARS frequency hopping VHF system. For test purposes, it should be feasible to use a wide variety of surrogates if any of these are not available. More challenging, however, is the fact the Army is equipping its OH-58D and AH-64 aircraft with the Automatic Target Handover System (ATHS). The Air Force is interested in the system and has demonstrated it on an F-16 aircraft. Since the ATHS would not be available for the other aircraft, some surrogate system that all aircraft could use needs to be identified.

One possible alternative to the ATHS, shown in Table III-3 would be using laser spot trackers (LSTs) that put symbology on the HUD to guide the pilot to the target in the same way the ATHS is designed to work. This would require that the targets be laser illuminated during the test trials. The A-10, A-7, and F-16 are all designed to carry the PAVE PENNY LST.

Also note from Table III-3 that only the A-10A is not expected to have a FLIR, although at one time it was considered for equippage with LANTIRN. If any night flying is contemplated during the test, some expedients, such as battlefield illumination, would have to be identified for A-10A use during the test.

Table III-3. Test Article Avionics and Weapons Configurations Phase I Modification Test Design

AVIONICS AND WEAPONS	POTENTIAL TEST ARTICLES		
	A-10A	A-7	A-16
AVIONICS:			
ATHS	No	No	Yes
LST	Yes	Yes	Yes
FLIR	No	Yes	Yes
WEAPON:			
GUN	30mm	20mm	30mm
MAVERICK	Yes	Yes	Yes
BOMBS	Yes	Yes	Yes
TMD	Yes	Yes	Yes

b. Weapons

Many of today's weapons, including missiles and cannons also shown in Table III-3, require the pilot to track an individual target for a period of time in order to destroy it. These types of weapons are not compatible with the concept of multiple kills on a single pass. That implies some type of effective cluster weapon for use with a Tactical Munitions Dispenser (TMD). In that case, accurate IFF and safe separation distances between friendly and enemy forces would be of paramount concern.

c. Countermeasures

All aircraft scheduled to participate in the Phase I test should be equipped with standard tactical countermeasures such as radar warning receivers (RWRs); missile warning systems, if available; chaff and flare dispensers; and electronic jammers (pod or internal as appropriate). While it will likely be necessary to simulate the effects of some of these systems, it is still desirable to include them in the test to identify other effects such as consistency in turning the systems on at the right time, limitations on maneuver or payload, and possible mutual interference with other systems.

3. Phase II, Competitive Fly-Off Test Articles

Both the actual test articles to participate in the Competitive Fly-off Test and their specific configuration will be determined after completion of the Phase I Modification Decision Test. Potential candidates for the Phase II test are listed in Table II-2.

D. SITE SELECTION

1. Introduction

Several candidate test sites have been considered for conducting the CAS operational test. The initial step in their evaluation was to collect data on the various test sites. By comparing various attributes of the test sites, a preliminary assessment was made of each site's suitability to support the test. After a preliminary review, points of contact at selected test locations were queried to fill in any data gaps and update outdated information. This initial screening process assisted in reducing the number of candidate sites. A list of the sites initially considered is provided in Table III-4.

Table III-4. List of Potential Test Sites

China Lake, CA	Ft. Huachuca, AZ
Cold Lake, Canada	Ft. Hunter Liggett, CA
Eglin AFB, FL	Ft. Irwin, CA
Ft. Bragg, NC	Ft. Knox, KY
Ft. Bliss, TX	Nellis AFB, NE
Ft. Campbell, KY	Redstone Arsenal, AL
Ft. Chaffee, AR	White Sands Missile Range, NM
Ft. Hood, TX	Yuma Proving Ground, AZ

A description of the attributes used to compare the candidate test sites is provided below.

2. Site Selection Factors

The final selection of a test site will be based on a number of key factors which are discussed below. Nevertheless, the availability of required instrumentation and sufficient ground forces will likely be the major considerations in selecting appropriate test sites for the CAS test.

a. Availability of Ground Force Participants

The availability of ground forces on the installation or within commuting distance of the test site is a major consideration in the site selection process. If the supporting test installation can provide ground forces and tactical vehicles (tracked and wheeled) to the test, this can significantly reduce the logistic and base support costs of the test. Many of the problems inherent in providing billeting, feeding, maintenance and supply, transportation, medical treatment, and administrative support are minimized if ground force participants and equipment can be provided by the host installation.

b. Availability of Required Instrumentation

The availability of required instrumentation, either fixed or transportable, at the test location(s) is a prime consideration. The instrumentation requirements to support the CAS testing are identified in Section II. F.

The TSPI requirement for tracking multiple CAS aircraft and ground maneuvering targets is of paramount importance. There are many test locations with either multilateration or multiple single target tracking radar systems that can provide multiple target tracking capability. These systems vary in their ranges, accuracy and update rates. Some of these systems may not be accurate enough to meet the CAS TSPI data requirements. The JMOTF Mobile Instrumentation Capability is available to augment existing range instrumentation systems and will be used to the maximum extent feasible. Laser trackers and optical tracker TSPI systems provide an increased accuracy capability. However, the increased accuracy must be weighted against other factors, such as target acquisition capability, range, and data reduction time and costs.

Additional factors to be considered in this area are the availability and adequacy of the organic test control communications and supporting backbone microwave communications between the test site and test control facilities and/or data processing facility. Other factors include the capability to remotely control ground maneuvering targets (if used), and possibly near real-time display and assessment systems.

Most transportable TSPI systems require permanent or semi-permanent pads for deployment. Construction and procurement lead times must be considered if the test location does not have existing instrumentation sites. If new site construction is needed, the required environmental assessment or surveys could add delays.

c. Installation and Range Support

Installation and range support capabilities are also key to the successful execution of a large scale test. Installation support in the areas of billeting, messing, transportation, medical treatment, personnel, maintenance and supplies, personnel services, etc. can alleviate many of the personnel and logistic support problems in conducting a test. Range support in areas of threat equipment operations and maintenance, test control communications, logistic facilities and services, instrumentation and data processing, geodetic survey, security, and medical treatment are also extremely important. Where an existing range support capability exists and can support the testing, it is a definite asset.

d. Range Limitations and Airspace Restrictions

Certain range limitations or airspace restrictions may make some test sites unsuitable for testing. Other range restrictions may dictate the test lay down and scenario to be followed during the test, or impose constraints on the test. For example, some ranges have restrictions against cross country travel and vehicles may be limited to using existing tank trails. Other areas may have historical or archaeological sites that prevent use of the entire range. Environmental surveys may have to be completed. Airspace restrictions, such as no overflights over certain areas below some specified altitude, or through commercial flight corridors, could limit testing or make the area unsuitable for CAS testing. Restrictions against conducting electronic countermeasures and obtaining the required frequency clearances could limit or prevent testing at some locations.

The size of the land area of the test range and airspace are also important considerations. It would be desirable to have a number of geographically dispersed targets that could be assigned to the CAS aircraft, and to have the ability to move or maneuver targets throughout the test range. It would be desirable to have unrestricted use of the airspace over the test range during test periods.

e. Availability of On-Site Threat Systems

The availability of threat systems on site or in close proximity to the test site can significantly affect the cost of conducting the test and time to set up, integrate, and check out the threat systems. An Integrated Air Defense System (IADS) threat will be deployed to support the CAS test. The Army Development and Acquisition of Threat Systems (ADATS) at Fort Bliss, Texas, and the Tonopah Electronic Combat Range (TECR) at Nellis AFB, Nevada, are the primary sources of IADS threat equipment. The Joint Mobile

Operational Test Force (JMOTF), operating at various CONUS locations under the direction of the DOT&E Capability Improvement Program, also possesses certain items of command and control (C^2) and communications and other air and ground threat equipment that can augment the ADATS and TECR threat capabilities.

The ADATS threat equipment is transportable and has been deployed to a number of test locations. The JMOTF assets are also transportable and are designed to support tests at various locations. The TECR assets are transportable, but are not readily available for redeployment to other test sites.

f. Proximity of Aircraft Basing

For the CAS test it would be desirable for the aircraft beddown and maintenance facilities to be within 30 minutes or less of the target area. An air base that normally supports one or more of the CAS type aircraft would be preferable to an air base that normally supports different type aircraft or an Army airfield that does not have any Air Force peculiar aircraft support capability. Another benefit would be a TSPI system that could track the CAS aircraft from takeoff throughout the entire CAS mission until returning to the egress check point. This would eliminate the need to implement special procedures to acquire the CAS aircraft by the TSPI system before the start of each trial. If the CAS aircraft are required to fly to some fixed orbit while the tracking TSPI system attempts to establish lock-on, this could provide an unwanted early warning cuing opportunity for the deployed IADS long range radar systems.

g. Scenario Representation

Ideally, the CAS test would be conducted at more than one location to replicate the three different test scenarios. These scenarios vary in climate, topography, and vegetation. Among the different conditions significantly affecting visibility are snow, fog, rain, dust, battlefield smoke and obscurants and light conditions (daylight or nighttime). The topography of the scenarios varies from flat plains with little terrain masking to mountains. The terrain significantly affects trafficability of ground tracked and wheeled vehicles. The vegetation of the scenarios varies from sparse desert offering little or no concealment, to heavy wooded areas, to the tropical jungles with dense foliage and overhead concealment.

h. Accessibility

Accessibility to the test range by road, rail, and air is also a planning consideration, particularly if the test location is not in close proximity to the test participant home station or does not have the requisite instrumentation or threat systems to support the test.

3. Summary

Members or representatives of the CAS Test Planning Group have visited the most likely test locations, met with key representatives at each site and evaluated the test ranges and support facilities. These site surveys were instrumental in verifying the attributes of each test site and determining the suitability of the potential test sites.

Although not specifically mentioned in the aforementioned site selection factors, cost and available range scheduling will have a major impact on the site selections. On the basis of assessments made to date the three most promising candidates appear to be Fort Hood, Texas; Fort Bliss, Texas/White Sands Missile Range, New Mexico; and Fort Hunter Liggett, California. Throughout the remainder of this document, it will be assumed that the Phase I Modification Decision Test will be conducted at Fort Hood, Texas. The site for the Phase II Competitive Fly-off Test will be determined in conjunction with the decision to conduct that test.

E. TEST CONTROL

The ultimate user of CAS, the ground commander, should be responsible for defining the specific tactical circumstances that require employing CAS, and for insuring those circumstances are faithfully replicated in a test of CAS aircraft. Furthermore, the majority of the resources, e.g., forces, equipment, instrumentation, required to support the test will be provided by the Army, and the most likely test sites are all active Army installations. Therefore it is recommended that the Army be designated the Executive Agent for conducting Phase I of the proposed CAS operational tests described in this document. Control of Phase II will be addressed as part of the decision to execute that phase.

To fulfill this responsibility a Test Directorate should be established at the test site to coordinate and supervise all pre-test planning, test execution and post-test assessment activities. A proposed Test Directorate organizational structure, involving participation by the Army, Air Force and Marine Corps is described in Figure III-1. Preliminary estimates indicate approximately 350 military and civilian personnel would be required to carry out

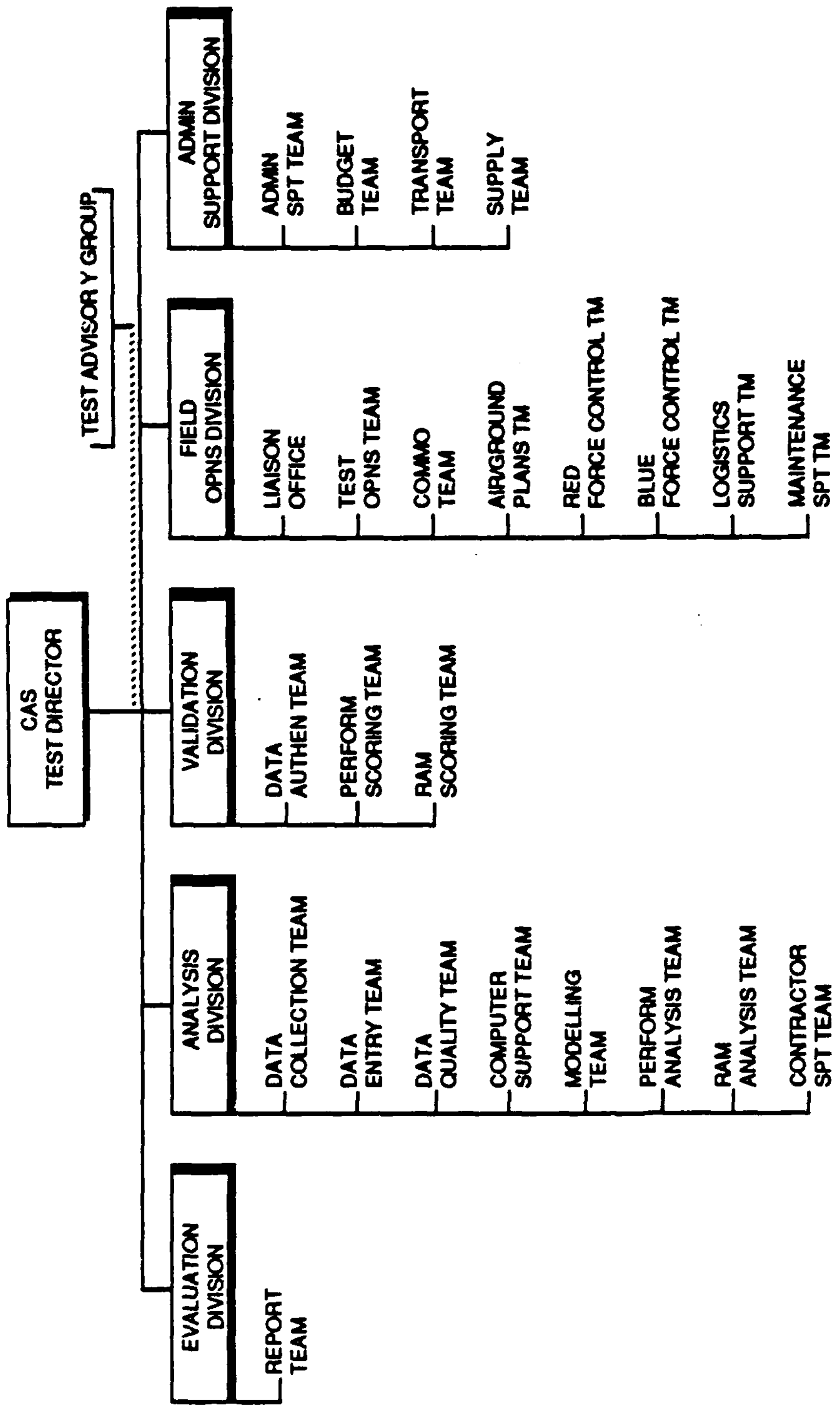


Figure III-1. Operational Test Directorate Close Air Support - Phase I

the functions indicated. A more detailed description of the proposed distribution of personnel is provided in Appendix B. Note that this organization was developed primarily to facilitate the development of funding estimates, and changes may be required as detailed test planning progresses.

The buildup of the proposed control organization would be phased over time, with activation approximately 12 months prior to the start of actual testing. Beginning with approximately 20 percent of the proposed manning, the strength of the organization would grow to about 50 percent of authorized strength 6 months prior to the test date. The balance of the control personnel would be required on-station at least 45 days prior to the start of testing.

In view of the large commitment of Army forces required to support this test and likelihood of using an active Army installation as test site, it is recommended that the Test Director be a senior Army General Officer with operational responsibilities. A proposed Terms of Reference, describing the duties of the Test Director, is provided at Appendix G. Both technical and tactical support needed to design and conduct the test would be provided by the Army's Test and Experimentation Command (TEXCOM) and Operational Test and Evaluation Agency (OTEA), the Air Force's Operational Test and Evaluation Center (AFOTEC) and the Marine Corps' Operational Test and Evaluation Activity (MCOTEA). The U. S. Army OTEA will submit a multi-Service report to DOT&E. Evaluation of the data obtained during the test will be performed by DOT&E.

F. USE OF MODELS, SIMULATION AND SIMULATORS

A proposed architecture for modeling, simulation and simulators for the CAS test is shown in Figure III-2.

1. Models

Modeling will be used in the pre-test, test, and post-test phases of both field tests for sensitivity analyses, test planning, flyouts of missiles and munitions, quality control of test data and extrapolations of test data to more complex scenarios.

Modeling will be necessary that involves SAMs and other ground threats to CAS aircraft including acquisition, tracking, and launch/flyout functions for one versus one up

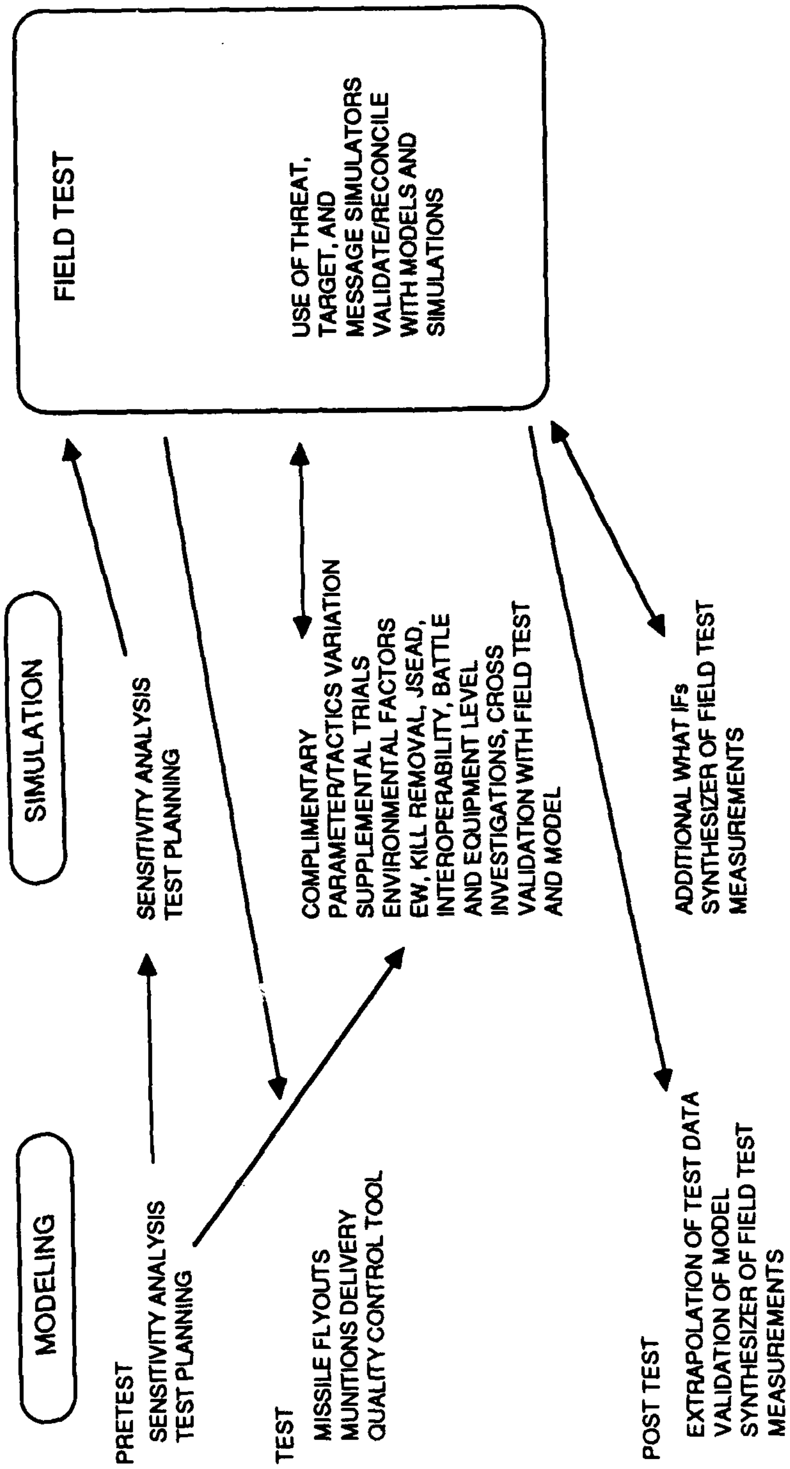


Figure III-2. CAS Modeling and Simulation Architecture

to raid level. The modeling, such as Suppressor with ESAMS for example, will be used initially, in pre-test, to investigate the sensitivity of CAS aircraft flight scenarios and their survivability to specific threats. In this manner, the specific threats and densities necessary for field testing can be identified or supported.

Modeling may also be used to investigate sensitivities of aircraft survivability resulting from tactics employed, size of strike packages, EW employed, and amount of joint suppression conducted, if current studies do not provide that information. This investigation may also aid in planning the specific conditions and assets required for the field test.

During the test phase, modeling will be used to determine missile flyouts to establish aircraft kills using field measured flight characteristics as input. Flyout models will use actual trial data to determine miss distances based on predicted missile trajectories and flight profiles. Given these miss distances, data from the Joint Munitions Effectiveness Manual can be used to assess aircraft losses. Modeling may also supplement munitions delivery data obtained in field tests, as necessary, to determined U. S. kills of friendly forces, or fratricide. Modeling will also provide a baseline of likely test outcome for the missions flown to determine if the test outcome is occurring as expected, thus providing a quality control mechanism.

Criteria for model selection will involve ease of use, credibility within the test and evaluation community, sufficient fidelity for the described uses, degree of modification required, risk, and security level. Once the criteria are weighted, a hierarchical attribute decision process will be used to select the appropriate candidates. Model candidates by class are shown in Figure III-3.

2. Man-in-the-loop Simulation (MILS)

MILS will play a major role in the planning and conduct of the CAS field tests. Smulation will be used to determine potential control problems and sensitivities in the test design. This will allow exploration of the distribution of planned trials and data acquisition techniques and needs. If a valid correlation with actual flight trials can be established, MILS could be an adjunct to test execution that will enable variation of parameters not possible during actual trials - such as terrain, weather, and night conditions - without safety concerns.

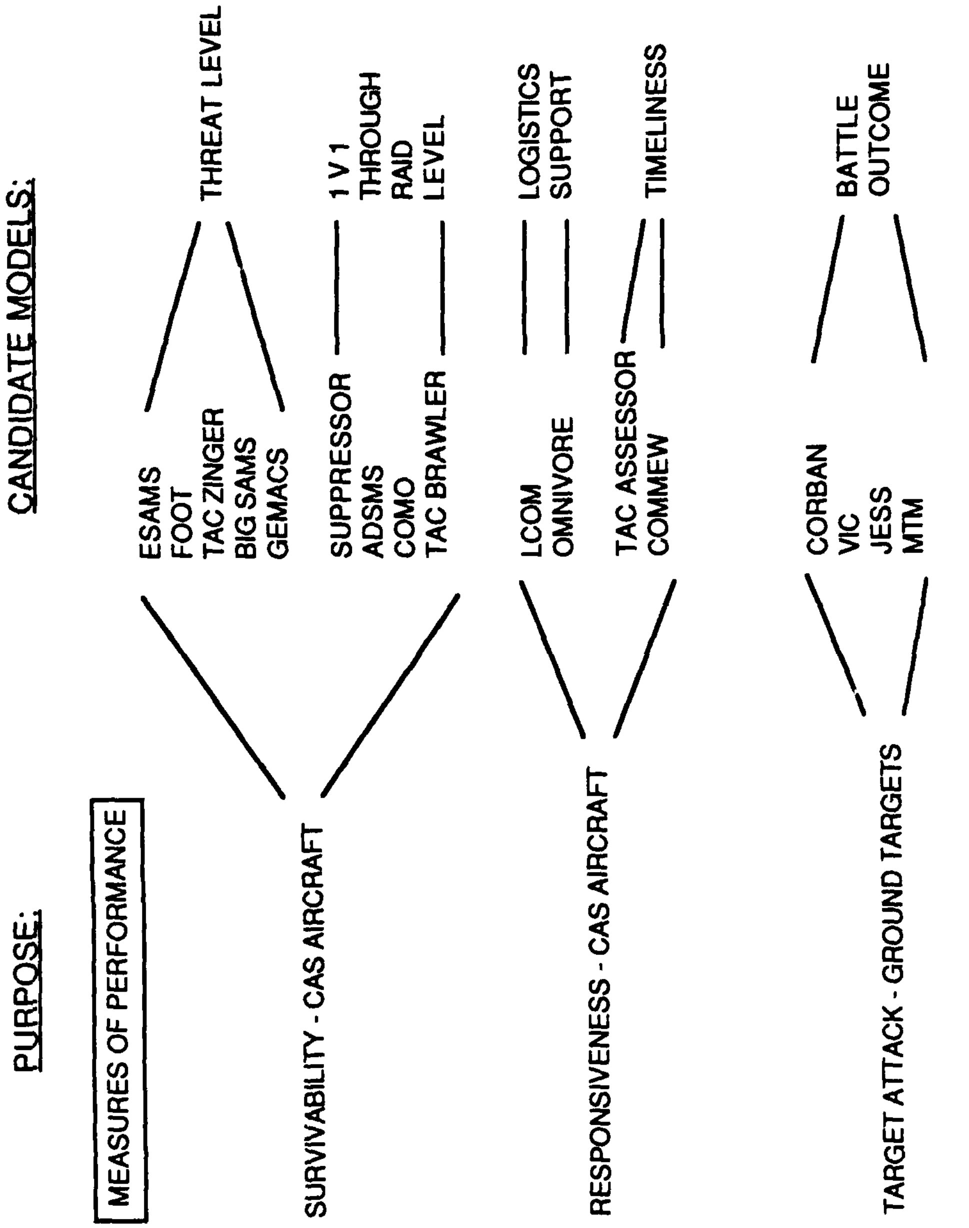


Figure III-3. Modeling for CAS Evaluation

It may also be possible to investigate tactics/techniques related to electronic countermeasures, suppression of enemy air defenses, interoperability and signature reduction. Further it will provide a larger number of trials for each area of interest (i.e., fill in the gaps with the test matrix not sufficiently addressed by field testing), a more controlled environment in which key measures can be made and real time kill assessments made and players removed from the battle. MILS has the potential to save valuable resources in the CAS test. A hybrid of several interlinked MILS simulations is presented here that would supplement field testing and offer a comprehensive test and evaluation of the CAS aircraft. If the cost, development risk, or schedule for the overall MILS is too great, the hybrid could be broken down into individual equipment level or battle simulation level tests that cover more specific measures or test conditions. The hybrid architecture would involve use of the actual contractor flight simulation for each of the candidate systems, or generic air-to-ground flight simulation (available at several contractor facilities) that has been programmed to represent the candidate systems interlinked with other simulations for battle management and for other U. S. and enemy ground systems involved in individual conflict. The battle management simulation could allow a battle to unfold creating vignettes of conflict that could be conducted off-line and the results fed back into the master battle. The forces in contact could be played in another simulation (e.g., armored units in contact via the DARPA-sponsored simulation network, SIMNET) and requests for air support could be made from that situation to the battle management simulation. The air support would be flown in the contractor flight simulations that would be made to interact with the other simulations. This real time hybrid, while technically feasible, may not be possible with the budget, risk, and time constraints imposed. However, non-real-time input from one simulation to another would be possible at lower cost and risk. This architecture serves to describe the level of fidelity and warfare simulation now possible at individual facilities that for each level of integration offers corresponding increases in the comprehensiveness of the CAS evaluation.

The potential for conflict of interest in using contractor facilities (especially those with an interest in the outcome of the CAS evaluation) can be avoided by using an independent organization to validate the facilities used, perform the test, and analyze the outcome.

The criteria for the MILS facilities selected will include test and evaluation community credibility, availability, cost, level of fidelity possible relative to that desired for each of the primary measures, perceived or actual conflict of interest resolution, and risk.

Facilities selection will follow procedures similar to that described for models. MILS candidates by category are shown in Figure III-4.

3. Actual Threats/Simulators

Actual threat systems owned and operated by the Services and the JMOTF will be used whenever available. This will ensure the most realistic threat environment possible. Simulators will allow field testing to be more realistic in the absence of critical threat assets or scenario densities that are impractical or impossible to represent with the actual systems. Specifically, threat simulators can replicate advanced threats not currently available. There are several acquisition efforts underway through the Defense Test and Evaluation Support Agency (DTESA) and the Army Development Acquisition of Threat Simulators (ADATS) that could support field testing by providing the specific threats determined to be the primary considerations in the desired timeframe and critical battle scenarios.

Additionally, target generator systems will be investigated similar to those created for the Over-the-Horizon Backscatter Radar OT&E. These target generators would sufficiently stress the threat system radars to mitigate "one versus many" biases. Such generators could create "sim over live" target densities to keep all the threat operators from focusing on single aircraft flying into their threat envelope.

Criteria for selecting the simulators will include cost, comparison to other options, availability (at the selected field test site), risk, credibility, degree of fidelity, and security/range constraints on use.

G. FUNDING

The purpose of this section is to summarize preliminary estimates of the costs of conducting the CAS operational tests described in Chapter II. Due to the greater uncertainty associated with the Phase II Competitive Fly-Off Test, the focus of this discussion is on the near-term Phase I Modification Decision Test. The estimates described below are based on a test involving three candidate aircraft: the A-10A, the A-7 and the A-16. Additional information is provided that can be used to extrapolate those costs to a test involving either more or fewer candidates, as deemed appropriate. Finally, on the basis of the Modification Decision Test costs described, a range of estimates of the likely costs of a subsequent Competitive Fly-Off is presented.

MAN-IN-THE-LOOP SIMULATIONS FOR CAS EVALUATION

EQUIPMENT LEVEL:	FACILITY OWNERSHIP:
F/A-16	General Dynamics, Air Force
AV-8	McDonnell Douglas, Marines
A-10+	Fairchild, Air Force
A-7+	LTV, Air Force, Navy
AH-64	McDonnell Douglas, Army
DEVELOPMENTAL	(e.g. A-12 or ATA fighter at several contractor facilities)
GENERIC	Several Contractors - McDonnell Douglas, General Dynamics, Lockheed, Boeing, etc.

BATTLE LEVEL & SPECIAL	
Battlefield Integration Center Simulation (BICSIM)	General Dynamics
Simulation Network (SIMNET)	Defense Advanced Research Projects Agency, Army
Warrior Preparation Center(s)/Joint Warrior Center	USAFE/USAEUR, PACOM, JCS
Tactical Simulation (TACSIM)	Army, Air Force, Joint Tactical Fusion Program Office
Blue Flag	Air Force (TAC)
War Colleges	Army, Air Force, Navy
EW Simulations - AFEWES, PRIMES, REDCAP, ...	Air Force, Calspan ...

Figure III-4. Man-in-the-Loop Simulator (MILS) Candidates

1. The Modification Decision Test Cost Estimate

a. Assumptions

The following assumptions were used in developing an estimate of the cost of the proposed Modification Decision Test.

1. The test would involve three candidate aircraft: the A-10A, the A-7 and the A-16.
2. The test will be conducted at Fort Hood, Texas, during the latter half of FY 90, with CAS support provided out of Bergstrom AFB, Texas.
3. The test will last approximately 12 weeks, with 1 week devoted to pre-test training, 2 weeks of pre-test field trials to validate test methodology and data collection procedures, followed by 9 weeks of record testing. Each test week will include 4 days of tactical operations and 1 day devoted to test preparation, e.g., unit deployments, re-deployments, administrative moves, maintenance, etc.
4. The ground force players, both U.S. and enemy, required for the period indicated above are those previously listed in Tables III-1 and III-2.
5. In the case of enemy air defenses, a mix of ADATS and U. S. equipment has been assumed. Costs associated with this equipment include travel, maintenance, contractor support and transportation from Fort Bliss, Texas.
6. Visual modification kits were included for selected items of enemy equipment, e.g. tanks, artillery pieces and some air defense systems.
7. Ground force ammunition costs were based on the employment of a heavy brigade, in force-on-force trials involving MILES engagements, for a period of 12 weeks.
8. Costs related to the Test Control Organization are based on the manning levels described in Section E. of this chapter. Where necessary, experience gained from the Mobile Subscriber Equipment (MSE) operational test conducted at Fort Hood in late FY 88 and early FY 89 was used.
9. Costs related to CAS aircraft participation include the candidate aircraft flying hour costs, the cost of ferrying aircraft from home base to Bergstrom AFB, air crew and maintenance personnel per diem and the cost of transportation for support equipment.

b. Projected Costs

On the basis of the assumptions summarized above, a preliminary cost estimate was developed for the Modification Decision Test. This estimate, which is described in Table III-5, must necessarily be treated as very tentative, given the lack of a detailed test design at this time, and the likelihood that the concept proposed may very well have to be modified as detailed test planning progresses. The required funding is displayed by cost category and

Table III-5. Summary of Funding Support Required
Phase I Modification Decision Test
(Thousands of FY 89 Dollars)

Cost Category	Fiscal Year			Totals
	89	90	91	
Ground Force Players	-	8,400.0	-	8,400.0
ADATS	-	4,500.0	-	4,500.0
CAS Force	-	1,426.0	-	1,426.0
Other Support				
Ammunition	-	2,160.0	-	2,160.0
Test Control	380.0	6,300.0	200.0	6,880.0
Instrumentation	-	13,000.0	-	13,000.0
ADP Support	230.0	450.0	230.0	910.0
Simulation and models	1,000.0	3,000.0	1,000.0	5,000.0
Total Costs	1,610.0	39,236.0	1,430.0	42,276.0

fiscal year to emphasize the need for near-term support if the assumed FY 90 test date is to be met.

In summary, the cost of conducting the Modification Decision Test, as described above, is estimated to be approximately $42.3 M, in constant FY 89 dollars.

c. The Marginal Cost of Adding or Deleting a Candidate Aircraft

In developing the marginal cost of either adding or deleting a candidate aircraft to the Modification Decision Test, the cost of maintaining the test environment for a period of

3 weeks, the time needed to test an additional candidate, was estimated. This estimate includes the costs of maintaining the test control organization, the ground force players, to include the ADATS threat force, ammunition consumption, instrumentation and ADP support for 3 weeks. The simulation, simulator and models costs were assumed not to vary as a function of the number of candidate aircraft, and therefore were not included in this estimate. In addition, the costs to move a CAS candidate to the test site and support it for the 3 weeks required was also determined. A summary of the resulting marginal costs of adding a CAS candidate is provided in Table III-6. The estimated cost of adding an aircraft type to this test would be about $4.5M. Deleting a candidate would reduce total test costs by about the same amount.

Table III-6. The Costs Associated with Adding a CAS Candidate to the Modification Decision Test (Thousands of FY 89 Dollars)

Cost Category	Cost of Extending Test 3 Weeks
Ground Force	2,246.0
ADATS Threat	353.0
CAS Force	475.0
Other Support	
Ammunition	540.0
Test Control	863.0
Instrumentation	-
ADP	-
Total Costs	4,477.0

2. Competitive Fly-Off Test

Given the considerable uncertainties associated with the Phase II Competitive Fly-Off, it is difficult to provide precise estimates of the anticipated costs of conducting that test. It is feasible, however, to provide some indication of the range of possible costs based on extrapolations from the previously described Phase I test costs. Assuming the Phase II Competitive Fly-off Test is also conducted at Fort Hood only, a two-candidate aircraft fly-off would cost approximately $45.4M in FY 89 dollars; a six-candidate test

would cost approximately $101.6M in FY 89 dollars. These costs include an additional $17M for instrumentation in Phase II that is not included in the Phase I cost estimate.

Neither of the figures described above includes the cost of modifying the test aircraft or flight certifying them. Recent Air Force estimates presented to the CASMARG indicate it would take about $250M FY 89 dollars and 42 months measured from contract go-ahead, to properly prepare the four aircraft mentioned in the law, the A-7F, A-10C, A-16 and AV-8B, for a competitive fly-off. See Appendix F.

H. CAS TEST SCHEDULE AND CRITICAL MILESTONES

Figure III-5 provides a summary of the proposed CAS test schedule and associated critical milestones. Once a decision is made to conduct the Phase I test, the Test Directorate will be established at the test site and detailed test planning will begin. Approximately 15 months later the pilot test trials will begin, followed immediately thereafter by the record trials. Assuming there are three test aircraft to be evaluated, the Phase I test should be completed in approximately 12 weeks.

The scheduling of the Phase II Competitive Fly-Off is necessarily less certain. First, a decision to conduct the test must be made and the candidate aircraft must be identified. According to USAF estimates, it will then take approximately 42 months to modify and flight certify the selected aircraft, before actual testing can begin. The actual duration of the Phase II test will depend on the number of candidates ultimately designated to participate in the fly-off.

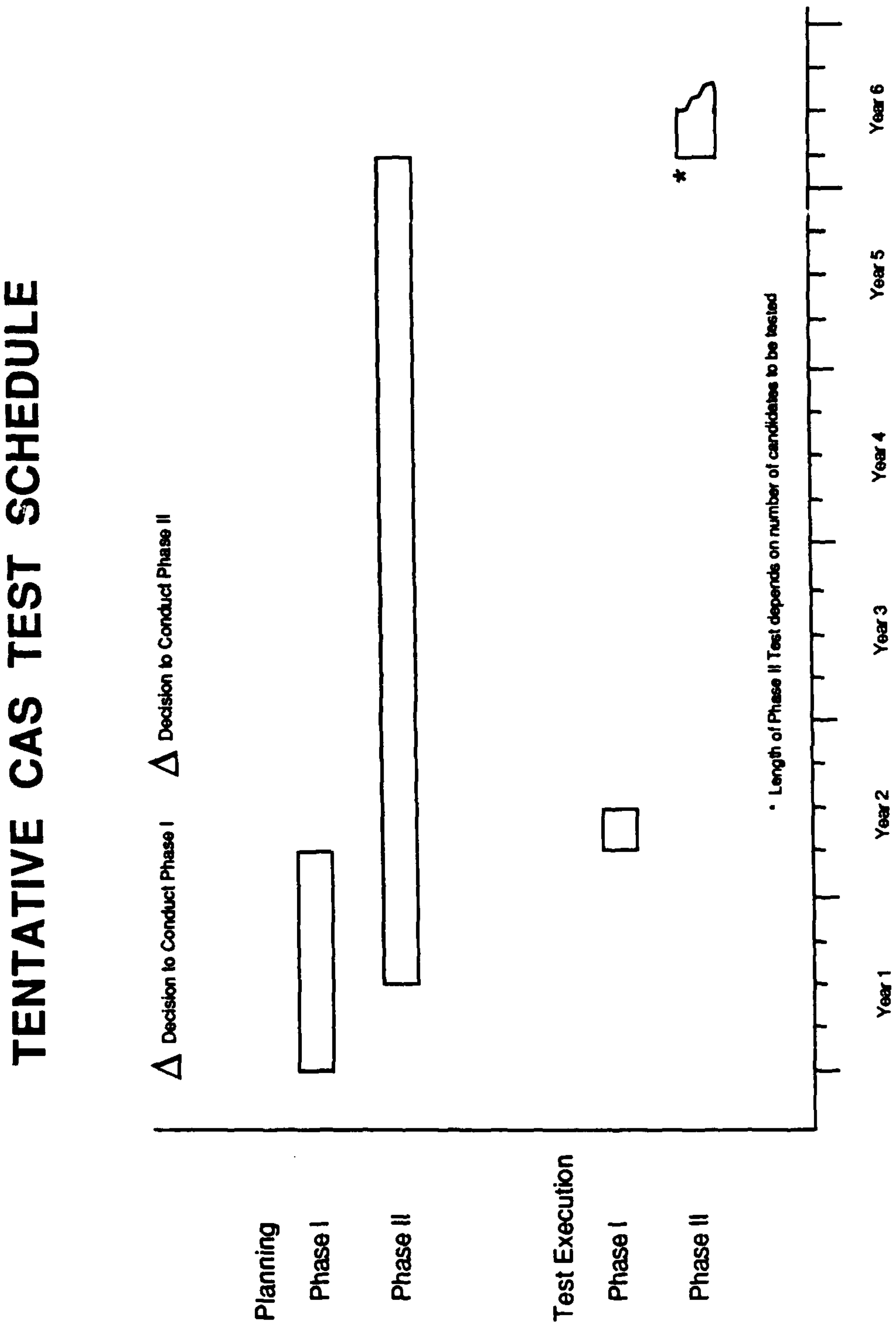


Figure III-5. Schedule of Critical Test Events

CHAPTER IV
POTENTIAL TEST LIMITATIONS

CHAPTER IV
POTENTIAL TEST LIMITATIONS

On the basis of preliminary assessments prepared in parallel with the test concept described in this plan, the following potential test limitations were identified.

A. TEST SITE SELECTION

It would be highly desirable to test the alternative CAS aircraft over a broad range of terrain and visibility conditions as discussed in Section II.B. In practice this would require conducting the test at several different sites. This is, however, impractical during Phase I for several reasons. There is a limited number of sites that have the instrumentation required to support such a test, and fewer yet provide ready access to the ground player personnel and equipment needed to create the proper operating environment. Transporting the ground player force, which in the Phase I test represents about one-third of a division, to alternative test sites would be very expensive. Furthermore, the lack of truly mobile instrumentation would still constrain the selection to those sites already instrumented. Therefore, trade-offs between instrumentation and player force availability, terrain and expected visibility conditions and costs must necessarily be made. The risk in selecting a single test site is that the test results observed may not be representative of all of the desirable conditions described in Section II.B.

B. THREAT AIR DEFENSES

An important aspect of any test of alternative aircraft performing the CAS mission is the representation of the threat air defenses. A credible threat involves the appropriate number, type and employment of projected enemy forces and equipment. The rapid modernization of the air defenses of likely adversaries, particularly in Central Europe, requires that surrogates and simulators frequently be used in lieu of the actual equipment. In many cases the surrogates and simulators used represent an older generation of very similar equipment, e.g., a surface-to-air missile fire unit is modernized with a new, more lethal missile. These approximations can frequently be compensated for through

appropriate instrumentation and data collection procedures, so that the use of the surrogate or simulator has little meaningful impact on the observed test results.

In other situations the differences are not so easily handled. For example, unclassified descriptions of the future Warsaw Pact threat in Central Europe indicate that the ZSU-23-4 guns and SA-13 SAMs currently in maneuver regiments will likely be replaced by the 2S6 gun/missile system. In the Phase I test described in this plan, the 2S6 will likely have to be represented by two separate systems: one mounting a gun; the other, a missile. Procedures will then have to be developed to insure that the two separate systems act and look like the one they are replicating.

C. COMBAT STRESSES ON THREAT AIR DEFENSES

Two aspects of combat that are difficult to capture adequately during peacetime exercises are suppression due to enemy action and realistic workloading of players. Suppression of enemy air defenses in the forward area results primarily from friendly direct and indirect fires. Workloading the air defenses involves insuring enemy crews and equipment are faced with a sufficiently realistic situation that precludes focusing an inordinate amount of attention on any single task, or target.

The two-sided, force-on-force test proposed will involve both maneuver and support (artillery and air defense) forces on both sides. Thus, enemy air defenses will have to compete with maneuver forces for the selection of firing positions, will have to displace periodically in accordance with the tactical situation and will therefore be subject to direct fire engagement by the friendly ground and helicopter force. This direct fire battle will help to create the desired suppressive effects and workload for some of the air defense systems.

The neutralization and destruction of enemy air defenses that result from indirect fires are, however, much more difficult to achieve. Fire units can be drawn down both prior to and during trials as a result of previous analyses and computer simulations. But the suppressive effects of indirect fires on those remaining, particularly the dismounted man-portable systems, can only be partially represented. In those tactical situations where the dismounted man-portable systems represent a significant component of the enemy air defenses, this influence could be considerable, but likely not critical to any relative comparisons of alternative CAS aircraft.

In the high and moderate intensity conflict scenarios proposed in this plan it is assumed there would be considerable air activity, both friendly and enemy, around the

FLOT, and that this activity would provide a significant workload for the primary enemy air defense systems and their command and control facilities. It is, of course, impossible to faithfully re-create this environment in an operational test. Therefore it is anticipated that the enemy air defense crews will be able to concentrate more than the usual amount of attention on the CAS alternatives during the test trials. This may affect the absolute values of the effectiveness measures of interest, but should not have a major effect on their relative comparisons.

D. COMBAT STRESS ON CAS CREWS

Our inability to faithfully replicate in a test all of the dangers existing on a real battlefield can also affect the participation of the air crews. In some instances, pilots receive realistic real time warning of an impending enemy action, such as when a radar warning receiver alerts the crew that the aircraft is being tracked. In other instances, the warning is less realistic. Examples of the latter include engagements by SAMs and guns, where firing signatures are less than adequate, and may not result in the appropriate evasive action on the part of the crew. If the crew is not properly stimulated, and correct evasive action is not taken, both aircraft survivability and air-to-ground target acquisition and engagement performance may be affected. While possibly having some affect on the absolute measurements taken during the test, this effect should not materially influence the relative comparison of CAS alternatives.

While it is not anticipated that real time casualty assessments will be made for surface-to-air engagements, particularly in the Phase I test, post-trial de-briefings of the aircrews will provide for learning between trials, allowing for adjustments in tactics analogous to what might take place on subsequent missions under real combat conditions.

APPENDIX A
LIST OF ACRONYMS

APPENDIX A
LIST OF ACRONYMS

ABCCC	Airborne Command and Control Center
ACP	Airborne Command Post
ACRV	Armored Combat Reconnaissance Vehicle
ADA	Air Defense Artillery
ADATS	Army Development and Acquisition of Threat Systems
ADP	Automatic Data Processing
AEWES	Air Force Electronic Warfare Effectiveness Simulation
AFB	Air Force Base
AFOTEC	Air Force Operational Test and Evaluation Center
AFV	Armored Fighting Vehicle
ALO	Air Liaison Officer
APC	Armored Personnel Carrier
ARLO	Air Reconnaissance Liaison Officer
ASOC	Air Support Operations Center
ATA	Air-to-Air
ATAF	Allied Tactical Air Forces
ATHS	Automatic Target Handoff System
ATO	Air Tasking Order
AWACS	Airborne Warning and Control System
BAI	Battlefield Air Interdiction
BCE	Battlefield Coordination Element
BICSIM	Battlefield Integration Center Simulation
BMP	Bronevaya Maschina Piekhota
C^2	Command and Control
C^3	Command, Control and Communications
CAP	Combat Air Patrol
CAS	Close Air Support
CASADA	Close Air Support Aircraft Design Alternatives
CASMARG	Close Air Support Mission Area Review Group
CONUS	Continental United States
CP	Coordinating Point
CRC	Control and Reporting Center
DAB	Defense Acquisition Board
DARPA	Defense Advanced Research Projects Agency
DoD	Department of Defense
DOT&E	Director, Operational Test and Evaluation
DTESA	Defense Test and Evaluation Support Activity

ECM	Electronic Countermeasures
ESAMS	Enhanced Surface-to-Air Missile System
EW	Electronic Warfare
FAC	Forward Air Controller
FACP	Forward Air Control Party
FIST	Fire Support Team
FLIR	Forward Looking Infrared
FLOT	Forward Line of Troops
FSCOORD	Fire Support Coordinator
FY	Fiscal Year
GLO	Ground Liaison Officer
HF	High Frequency
HUD	Heads-Up Display
IADS	Integrated Air Defense System
ID	Identification
IDA	Institute for Defense Analyses
IFF	Identification, Friend or Foe
IOC	Initial Operating Capability
IP	Initial Point
IR	Infrared
JAAT	Joint Air Attack Team
JCS	Joint Chiefs of Staff
JMEM	Joint Munitions Effectiveness Manual
JMOTF	Joint Mobile Operational Test Force
LANTIRN	Low Altitude Navigation and Targeting Infrared System for Night
LST	Laser Spot Tracker
MCOTEA	Marine Corp Operational Test and Evaluation Activity
MILES	Multiple Integrated Laser Engagement System
MILS	Man-in-the Loop Simulation
MNS	Mission Need
MOP	Measures of Performance
MPADS	Man-portable Air Defense System
MSE	Mobile Subscriber Equipment
MTOE	Modified Tables of Organization and Equipment
OJCS	Office, Joint Chiefs of Staff
OPS	Operations
OSD	Office of the Secretary of Defense
OTEA	Operational Test and Evaluation Agency (United States Army)
OTS	Over-the-Shoulder

PACOM	Pacific Command
PL	Position Location
RAM	Reliability, Availability and Maintainability
RRS	Range Reference System
RWR	Radar Warning Receiver
SAM	Surface-to-Air Missile
SEAD	Suppression of Enemy Air Defenses
SIMNET	Simulation Network
SINCGARS	Single Channel Ground and Airborne Radio System
TAC	Tactical Air Command
TAC-A	Tactical Air Coordinator-Airborne
TACC	Tactical Air Control Center
TACP	Tactical Air Control Party
TACS	Tactical Air Control System
TACSIM	Tactical Simulation
TACWAR	Tactical Warfare
TARN	Tactical Air Request Net
TECR	Tonopah Electronic Combat Range
TEXCOM	Test and Experimentation Command (United States Army)
TMD	Tactical Munitions Dispenser
TOC	Tactical Operations Center
TRADOC	Training and Doctrine Command (United States Army)
TSPI	Time, Space, Position Information
USAEUR	United States Army, Europe
USAF	United States Air Force
USAFE	United States Air Forces, Europe
USCENTCOM	United States Central Command
V/STOL	Vertical/Short Take-off and Landing
VHF	Very High Frequency
Vis Mod	Visual Modification
WOC	Wing Operations Center

APPENDIX B
TEST CONTROL ORGANIZATION
(PERSONNEL LISTING)

APPENDIX B
TEST CONTROL ORGANIZATION
(PERSONNEL LISTING)

Duty	Grade	Authorization
Office of the CAS Test Director		
Test Director	GO	1
Dep Director	06	1
Dep Director	06	1
Dep Director	06	1
Executive Officer	05	1
Assistant Executive Officer	04	1
Driver	E4	3
Secretary/Steno	GS9	1
Secretary	GS7	2
Test Advisory Group		
Test Advisor		
Test Advisor		
Test Advisor		
Test Advisor		
Evaluation Division		
Senior Evaluator	06	1
Evaluator	05	1
Evaluator	05	1
Evaluator	05	1
Analyst	04	1
Analyst	05	1
Driver	E4	2
Secretary	GS6	2
Analysis Division		
Chief	GM15	1
Deputy	05	1
Analyst	05	1
Driver	E4	2
Secretary	GS5	1
Data Collection Team		
Chief	03	1
Deputy	03	1
Aircraw Debriefers	02	3

Duty	Grade	Authorization
Protocol Officer	03	1
Secretary	GS6	1
Admin Support Team		
Chief	03	1
Security Officer	GS9	1
Admin NCO	E7	1
Admin Spec	E5	3
Distribution Clerk	E4	2
Secretary	GS5	3
Budget Team		
Budget Officer	03	1
Contract Spec	GS12	1
Contract Spec	GS12	1
Budget Spec	GS12	1
Admin Spec	E4	1
Finance Spec	E5	1
Transportation Team		
Chief	03	1
Operations Sergeant	E7	1
Dispatcher	E5	1
Drivers	E3	10
Supply Team		
Chief	03	1
Property Book	WO	1
Supply NCO	E7	1
Supply NCO	E6	1
Supply Clerk	E4	1
Supply Clerk	E4	1

Duty	Grade	Authorization
Blue Force Debriefers	02	2
Red Force Debriefers	02	2
Data Collectors	E6	1
Data Collectors	E5	10
Data Collectors	E4	35
Data Collectors	E5	5
Data Collectors	E4	20
Driver	E4	20
Secretary	GS5	1
Data Entry Team		
Chief	03	1
Deputy	03	1
Data Entry Clerk	GS5	5
Secretary	GS5	1
Data Quality Control Team		
Chief	03	1
Data Quality Analyst	GS12	1
Data Quality Analyst	GS9	5
Secretary	GS5	1
Computer Support Team		
Chief	GS12	1
Computer Specialist	03	1
Computer Specialist	03	1
Computer Operators	GS9	3
Computer Operators	GS7	9
Modeling Team		
Chief	05	1
Analyst	05	3
Analyst	04	3
Secretary	GS5	1
Performance Analysis Team		
Chief	05	1
Senior Analyst	GS14	1
Analyst	04	2
Analyst	04	2
Secretary	GS5	1

Duty	Grade	Authorization
Ram Analysis Team		
Chief	05	1
Deputy	04	1
RAM Engineer	GS13	2
Engineer	GS12	2
Analyst	03	1
Secretary	GS5	1
Validation Division		
Chief	GM15	1
Deputy	05	1
Driver	E4	1
Secretary	GS5	1
Data Authentication Team		
Chief	03	1
Senior Analyst	GS14	1
Ops Analyst	GS12	1
Ops Analyst	GS12	1
Ops Analyst	GS5	1
Secretary		1
Performance Scoring Team		
Chief	04	1
Analyst	03	1
Analyst	03	2
Secretary	GS5	1
RAM Scoring Team		
Chief	04	1
RAM Engineer	GS12	1
RAM Engineer	GS12	1
Field Operations Division		
Chief	06	1
Deputy	05	1
Deputy	05	1
Security Officer	GS9	1
Driver	E4	2
Secretary	GS6	1

Duty	Grade	Authorization
Liaison Office	04	1
Red Ground Threat	04	1
Blue Ground Force	04	1
Blue Air		
Test Operations Team	05	1
Chief	04	1
Deputy	GS12	1
Safety Officer	03	2
Air Controllers	03	1
Operations Officer	E-7	1
Operations Sergeant	E-6	2
Operations Sergeant	E4	3
Driver	E5	1
Admin Spec	GS6	1
Secretary		
Communications Team	03	1
CE Opns Officer	03	1
CE Officer	03	1
EW Officer	E6	1
TAC Comm Spec	E5	3
TAC Comm Spec		
Air/Ground Plans Team	04	1
Chief	03	1
Deputy	03	1
Air Plans Officer	03	1
Ground Plans Officer	E6	1
Operations Sergeant	E5	3
Operations Sergeant	E6	1
Operations Sergeant	E5	3
Operations Sergeant	GS5	1
Secretary		
Red Force Control Team	03	1
Chief	E6	3
Controllers	E5	9
Controllers	E3	12
Driver		

Duty	Grade	Authorization
Blue Force Control Team		
Chief	03	1
Controllers	E6	3
Controllers	E5	9
Driver	E3	12
Logistics Support Team		
Chief	04	1
Deputy	03	1
Operations Sergeant	E6	1
Supply Sergeant	E6	1
Admin Spec	E5	1
Maintenance Support Team		
Chief	WO	1
Maintenance NCO	E7	1
Clerk	E3	1
Admin Support Division		
Chief	05	1
Deputy	04	1

APPENDIX C
AIR FORCE CAS SUPPORT FOR THE ARMY

APPENDIX C
AIR FORCE CAS SUPPORT FOR THE ARMY

One of the primary Air Force missions is providing CAS to Army ground forces. As defined in JCS Pub 1 (Chapter I), CAS is conducted against enemy targets in close proximity to friendly troops. CAS missions must therefore be fully integrated with the movement and fire support activities of the supported ground forces. The extensive process of integration and coordination is designed to assure that the air support requested by the ground commander is responsively delivered and the restrictive measures, including terminal control of the strike, are imposed to insure the safety of troops from air-delivered ordnance and of aircrews from ground-delivered fires.

The detailed integration of air and ground firepower is the responsibility of the tactical elements shown in Figure C-1. The Air Force CAS structure parallels Army organizational echelons at every level from battalion through corps. The TACC is the focal point for Air Force operational command-level coordination with the joint force command structure. It is responsible for all air support planning, for preparing and supervising execution of the daily Air Tasking Order (ATO), and for coordinating and integrating all Air Force operations through the use of the Tactical Air Control System (TACS). The collocated Army Battlefield Coordination Element (BCE) provides the Army commanders' requirements for tactical air support, monitors and interprets the land battle situation, and provides coordination channels for the exchange of operational and intelligence data between the Army and Air Force.

The joint interface at Army corps level takes place at the Tactical Operations Center (TOC) of the supported ground force where the Air Force Air Support Operations Center (ASOC) is collocated. The ASOC is concerned primarily with the exchange of combat data between the air and ground forces and with the coordination and execution of close air support, tactical air reconnaissance, and tactical airlift for ground units.

At lower command echelons, the Air Force provides Tactical Air Control Parties (TACPs) that are collocated at division, brigade and battalion TOCs. These elements provide the detailed coordination needed to obtain, coordinate, and control tactical air support missions. Forward Air Controllers (FACs) and Air Liaison Officers (ALOs),

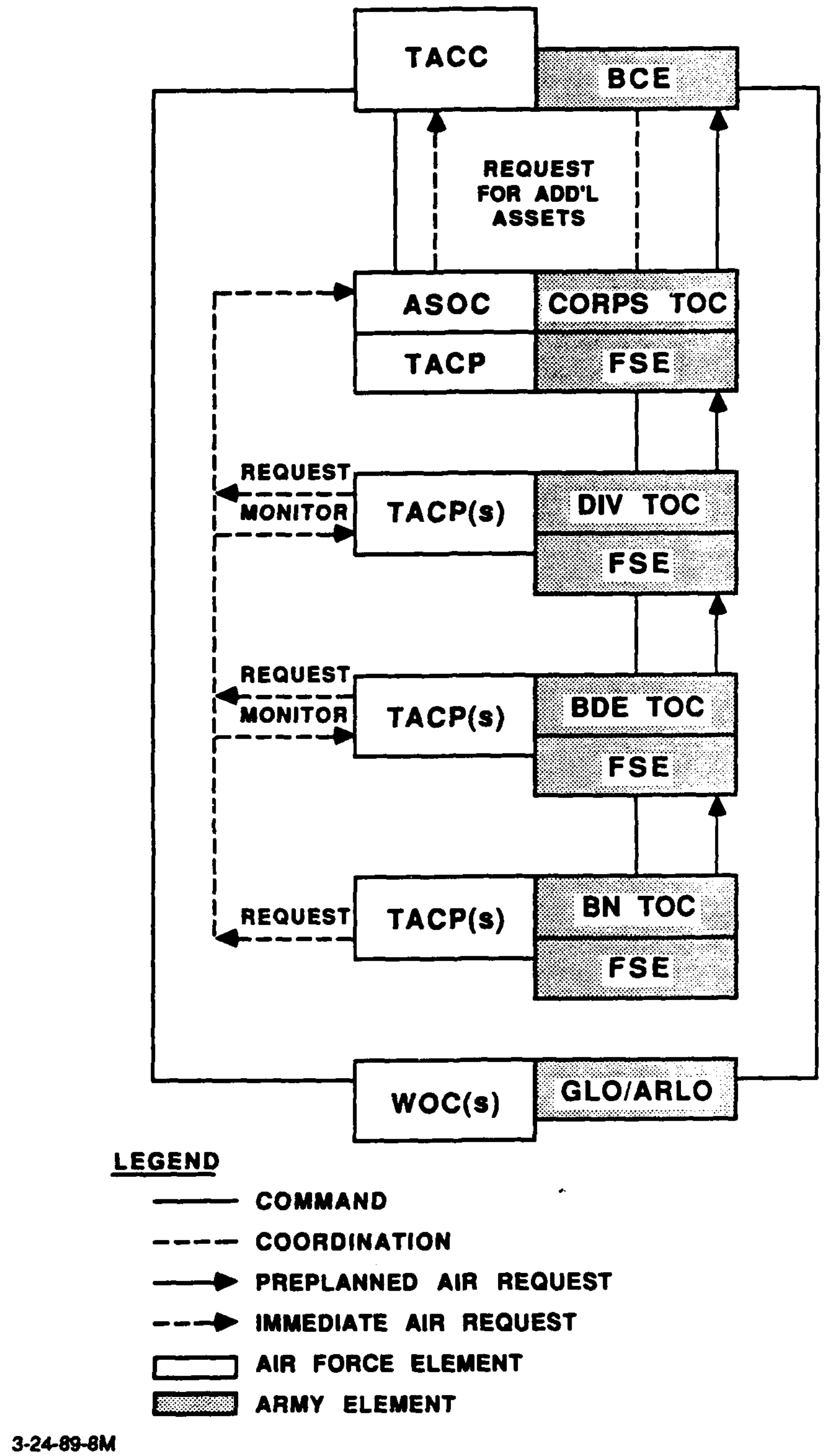


Figure C-1. Air Force/Army C^2 Structure for Coordinating Fire Support

which are part of the TACPs, actively assist specific ground units in employing CAS. Additionally, there are Army Ground Liaison Officers (GLOs) and Air Reconnaissance Liaison Officers (ARLOs), who are assigned to the BCE but are physically located at the various tactical Air Force wings to provide Army advice and assistance to Air Force aircrews.

As seen from Figure C-1, requests for both preplanned and immediate CAS flow from the lowest supported echelon to the higher. Preplanned CAS is performed to support planned Army ground maneuver operations and may be based upon intelligence reports and estimates. The requirements may be identified far enough in advance to permit detailed air planning, aircraft loading, and advanced coordination. Preplanned requests are submitted and coordinated through the Army chain of command. Each is evaluated, assigned a priority, and consolidated at each immediate level. The senior ground TOC decides which preplanned requests will be filled from its allocated CAS sorties and forwards a final preplanned target list to the Air Force TACC for action. The TACC then incorporates the missions in the next day's ATO. Preplanned CAS is preferred because of the time available for planning by the aircrew, selecting weapons tailored to the target, and coordinating ground support such as artillery for SEAD. The risk always exists with preplanned CAS that the situation that led to the request for CAS may have changed between the time the mission was requested and the time the CAS mission is executed.

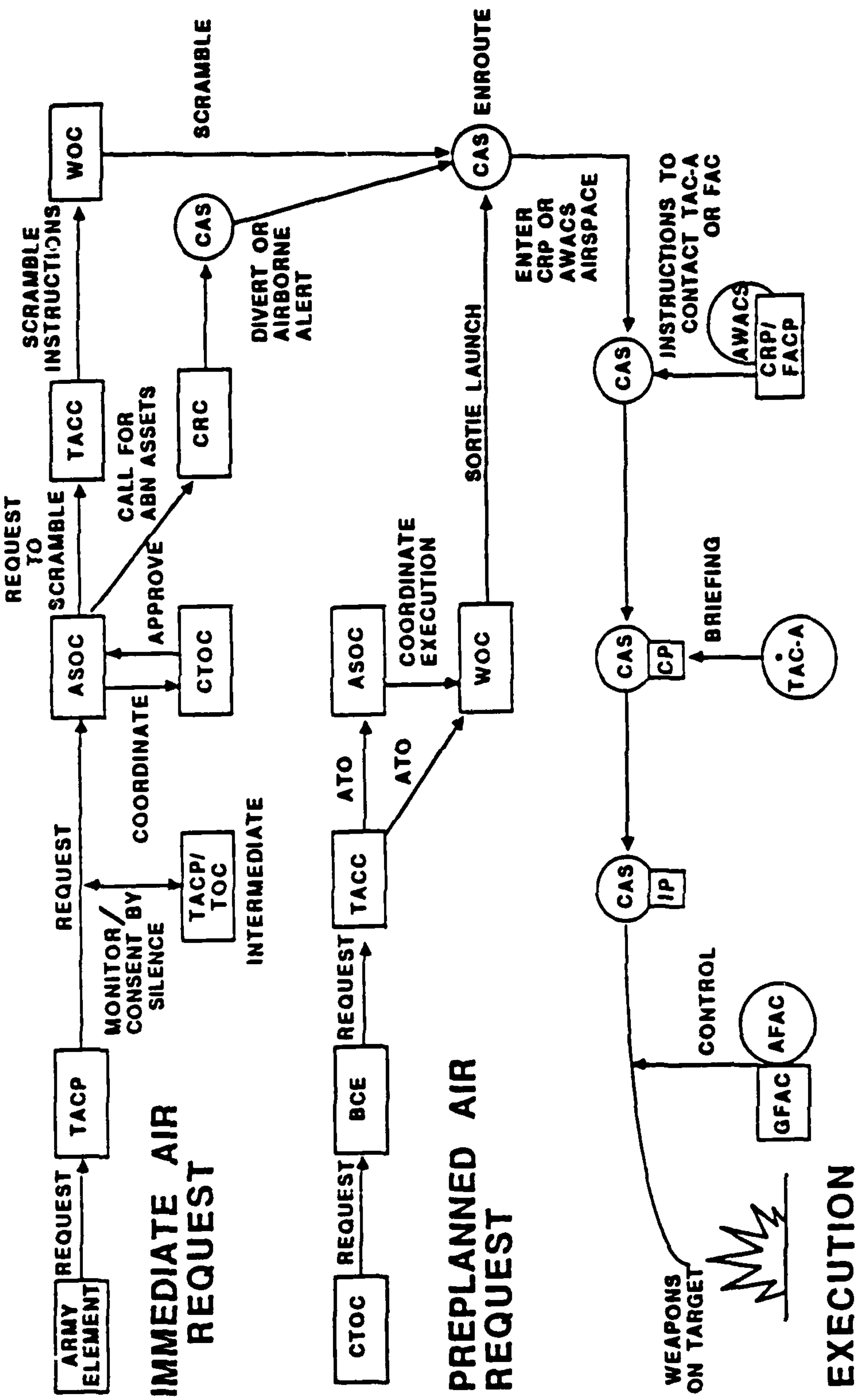
Immediate CAS requests are made over the HF Tactical Air Request Net (TARN). The request is made to the ASOC by the TACP assigned to the unit initiating the request. Intermediate level TACPs monitor the requests and coordinate with their Army counterparts to determine if the requests can be satisfied with organic Army means. Silence from an intermediate command level signifies approval of the CAS requests. Once the request has been coordinated and processed at the ASOC, the CAS requirement is passed to the executing aircraft. Air support aircraft may be on ground or airborne alert, or they may be diverted from preplanned missions.

In both preplanned and immediate CAS missions, the aircraft are directed to an orbit or contact point by the CRC or FACP and possibly AWACS. At the orbit or contact point, the aircraft are handed off to the FAC, or if the situation warrants, a Tactical Air Coordinator-Airborne (TAC-A) for a briefing. After contacting and authenticating the FAC, the CAS aircraft receive a briefing on the ground situation and mission, target marking means, threat suppression means, deconfliction with other airspace users, and

adjacent unit coordination. The FAC is directly involved in the attack to make on-the-scene adjustments and coordination, and to tailor the mission to the situation.

The CAS process described above is illustrated graphically in Figure C-2.

A special case of CAS involves Air Force aircraft operating with Army attack helicopters and scout helicopters in the Joint Air Attack Team (JAAT) operations. The JAAT is a team of U. S. Army attack and scout helicopters employed in concert with U. S. Air Force CAS aircraft, formed to attack the same target array. It provides the ground maneuver commander with a highly mobile, lethal, tank-killing force which can engage the enemy beyond the range of ground antitank weapons. Although most associated with antitank operations, the JAAT also has other applications including disruption of enemy command and control or adjustment of indirect fires. JAAT missions are requested by the ground commander, on the advice of the FSCOORD and ALO, through the preplanned or immediate request channels by specifying "JAAT MISSION" in the request. Link-up of the A-10s and the attack helicopters is achieved through the FAC who will coordinate the attack of the A-10s, with the Attack Helicopter Company Commander.



* TAC-A Function may be performed by ABCCC, AWACS or FAC-Type Aircraft

Figure C-2. Air Force/Army CAS Process

APPENDIX D
ALTERNATIVE TEST DESIGN CONCEPTS
(CLASSIFIED; TO BE DISTRIBUTED SEPARATELY)

APPENDIX E
THREAT AND THREAT REPRESENTATION
(CLASSIFIED; TO BE DISTRIBUTED SEPARATELY)

APPENDIX F
AIRCRAFT MODIFICATION COST AND SCHEDULE ESTIMATES

APPENDIX F
AIRCRAFT MODIFICATION COST AND SCHEDULE ESTIMATES*

FLY-OFF
CANDIDATE AIRCRAFT
COSTS AND SCHEDULE

ASSUMPTIONS:

- SCHEDULE IS FROM CONTRACT GO-AHEAD
- COSTS ARE FOR TWO AIRCRAFT
- COSTS ASSUME ACCEPTABLE AIR FORCE DATA PACKAGE FOR TESTING
  - -- EXCEPT AV-8B ARE DEM-VAL COSTS, NOT VALIDATED
  - -- COSTS DO NOT PRODUCE A PRODUCTION DATA PACKAGE

	A-7F	A-10C	A-16	AV-8B
COST	$42M	$55M	$88M	$7M
TIME	20 MOS	29 MOS	36 MOS	18 MOS

<u>BOTTOM LINE: YOU NEED $192M AND 36 MOS FROM CONTRACT GO-AHEAD</u>

FLIGHT TESTING REQUIREMENTS:

	A-7F	A-10C	A-16	AV-8B
COST	$12M	$20M	$12M	$12M
TIME	6 MOS	12 MOS	6 MOS	6 MOS

<u>BOTTOM LINE: YOU NEED AN ADDITIONAL $56M AND 12 MOS</u>

* Extracted from USAF Briefing to CASMARG, 10 February 1989

APPENDIX G

TERMS OF REFERENCE
TEST DIRECTOR, CLOSE AIR SUPPORT
OPERATIONAL TEST

TERMS OF REFERENCE
TEST DIRECTOR, CLOSE AIR SUPPORT
OPERATIONAL TEST

A Test Director will be appointed for the Close Air Support Operational Test and a Test Directorate will be established at the test site. The principal duties of the Test Director will be to coordinate and supervise all pre-test planning, test execution, post-test validation of data for accuracy and completeness, and to prepare a report of test results. Analysis and evaluation of the results will be accomplished and reported by the Director, Operational Test and Evaluation, Office of the Secretary of Defense.

The specific duties of the Test Director will be to:

(1) Establish, organize, direct, and supervise a functionally effective operational test;

(2) Ensure that the test is conducted so that it accomplishes the specified test objectives;

(3) Develop plans to guide the test (e.g., Final Test Design, Field Test Plan, Instrumentation Plan, Data Management Plan, Simulation Plan, Logistics Support Plan);

(4) Develop, maintain, and update requirements for OSD funding and for Service support; submit them to the DOT&E and the Services as appropriate;

(5) Control funds specifically designated for CAS Operational Test activities and account to the DOT&E for their use; monitor Service expenditures related to the test;

(6) Coordinate the use of required resources (e.g., forces, weapon systems, and simulations) and facilities (e.g., range and maneuver areas, test beds, and computers);

(7) Manage the acquisition and control of test peculiar resources;

(8) Coordinate the integration of the test into the training cycle of forces used in the test when possible and appropriate;

(9) Lead the data-generating field trials, war games, and simulations; collect and validate the data;

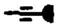
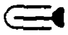
(10) Formulate the database, prepare summary statistics and brief the preliminary results;

(11) Prepare and submit interim and special reports, as required, a Final Test Report and a Test Management Report.

APPENDIX H
SUMMARY AND EXPLANATION OF SYMBOLS USED IN SCENARIO FIGURES

SUMMARY AND EXPLANATION OF SYMBOLS USED IN SCENARIO FIGURES

Equipment

	Tracked Vehicle
	Wheeled Vehicle
	Towed Antiaircraft Gun, e.g., ZU-23
	Tracked Antiaircraft Gun, e.g., ZSU-23-4
	Man-Portable Air Defense Missile System, e.g., SA-7, SA-14, SA-16, SA-18
	Tracked, Short-Range, Air Defense Missile System, e.g., SA-9, SA-13
	Tracked, Short-Range, Hybrid Gun/Missile Air Defense System, e.g., 2S6
	Wheeled, Medium-Range, Air Defense Missile System, e.g., SA-8
	Tracked, Long-Range, Air Defense Missile System, e.g., SA-4, SA-11
	Mortar
	Howitzer
	Antitank Guided Missile

Units

	Platoon Equivalent
	Company Equivalent
	Battalion Equivalent
	Armor
	Mechanized Infantry
	Artillery

Tactical Activity

	Attack Formation
	Defensive Position
	Temporary Firing Position